U. S. DEPARTMENT OF AGRICULTURE.

BUREAU OF SOILS—MILTON WHITNEY, Chief.

IN COOPERATION WITH THE WEST VIRGINIA GEOLOGICAL SURVEY,
I. C. WHITE, STATE GEOLOGIST.

SOIL SURVEY OF JEFFERSON, BERKELEY, AND MORGAN COUNTIES, WEST VIRGINIA.

BY

W. J. LATIMER.

W. EDWARD HEARN, INSPECTOR, SOUTHERN DIVISION.

[Advance Sheets—Field Operations of the Bureau of Soils, 1916.]

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1918.

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF SOILS,
Washington, D. C., June 9, 1917.

SIR: The accompanying report and soil map cover the survey of Jefferson, Berkeley, and Morgan Counties, W. Va., one of the projects undertaken by the bureau during the field season of 1916. This work was carried on in cooperation with the West Virginia Geological Survey, and the selection of this area was made after conference with State officials.

I recommend that the report and map covering this work be published as advance sheets of Field Operations of the Bureau of Soils for 1916, as provided by law.

Respectfully,

MILTON WHITNEY,
Chief of Bureau.

Hon. D. F. HOUSTON,
Secretary of Agriculture.

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SOIL SURVEY OF JEFFERSON, BERKELEY, AND MORGAN COUNTIES, WEST VIRGINIA.

By W. J. LATIMER.—Area Inspected by W. EDWARD HEARN.

DESCRIPTION OF THE AREA.

The area surveyed comprises Jefferson, Berkeley, and Morgan Counties, W. Va., and is located in the extreme eastern part of the State in what is known as the eastern panhandle. The counties take position from east to west in the order named. The Potomac River forms the entire northwestern, northern, and northeastern boundary, separating the area from Maryland. The eastern boundary follows the crest of South Mountain, a part of the Blue Ridge range. The southwestern boundary is formed by the Virginia State line and the line between Morgan County and Hampshire County, W. Va. Jefferson, the eastern county in the group, is the smallest, having an area of 212 square miles. Berkeley, the middle county, is the largest, with an area of 325 square miles, and Morgan, the western county, has an area of 232 square miles. The total area of the three counties is 769 square miles, or 492,160 acres.

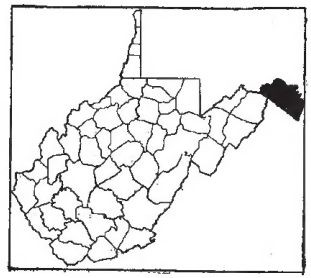

FIG. 1.—Sketch map showing location of the Jefferson, Berkeley, and Morgan Counties area, West Virginia.

The area lies wholly in the Appalachian Valley region. Physiographically it consists of a series of mountain ridges and intervening valleys, extending in a general northeast-southwest direction. The valleys are comparatively broad and fairly smooth, while the mountains are narrow and ridgelike, rising abruptly from the valleys and forming conspicuous features on an otherwise fairly even surface.

South Mountain extends along the southeastern border of the area. Between this mountain and North Mountain, which extends from the Potomac River to the Virginia line, stretches a broad limestone valley, referred to in this report as "the valley," "the limestone valley," or the Shenandoah Valley. This valley averages about 20 miles in width throughout the area. It has a smoothly rolling topography and lies about 1,000 feet below the general level of the mountains on either side. Lying between North Mountain and the Third Hill Mountain range is the Back Valley. This is a shale valley, much narrower than the Shenandoah Valley, averaging about 5 miles in width in the southern part and 7 miles in the northern part. This valley has about the same general elevation as the limestone valley.

Its surface is interrupted by two nearly parallel ridges united at the ends and inclosing a narrow limestone valley. They lie near the north-central part of the valley and are known as Wilson and Ferrell Ridges. The northern end of Back Valley curves around Devils Nose, the northern end of Third Hill Mountain, and merges with the Sleepy Creek Valley, which extends through the area between Warm Spring Ridge and Sleepy Creek Mountain, the latter lying parallel to and uniting at the ends with Third Hill Mountain. This valley is about 6 miles wide and lies slightly higher than Back Valley. Both valleys have a rolling to hilly surface broken by long, low ridges lying about 100 to 200 feet above the general level of the valley. Warm Spring Ridge lies about 300 to 400 feet above the Sleepy Creek Valley. Between this ridge and the base of Cacapon Mountain there is a limestone valley, with an average width of about one-half mile over its course from the Potomac River to within a short distance of the Virginia line, where it becomes narrower. This valley lies about 100 to 200 feet lower than Warm Spring Ridge. The surface is fairly smooth, the highest part of the valley adjoining the ridge, and the lowest part lying along the stream that flows at the base of Cacapon Mountain. A corresponding valley occurs intermittently along the western base of Cacapon Mountain and between it and Tonoloway Ridge. This valley is dissected to some extent by the Cacapon River.

Cacapon Mountain is the highest in the area. It stands 1,000 to 1,500 feet above the general level of the shale valleys, and averages about 1,000 feet higher than the minor ridges flanking its sides. Between Tonoloway Ridge and the base of Sideling Hill-Purslane Mountain lies a shale valley averaging about 2½ to 3 miles in width. This valley is known as the "Cacapon Valley," or "Long Valley," and is the counterpart of the Sleepy Creek Valley in elevation and topography. Sideling Hill Mountain extends from the Potomac River to the Hampshire County line. It is about 1,000 feet above the general level of the surrounding shale valleys. From the western base of Purslane Mountain to the Potomac River and into the large bends developed by the river in this region extends a shale valley, thoroughly dissected by the river and its tributaries.

The mountain ridges in general have steep slopes on the sides and somewhat uneven crest lines. The higher points fall into a general alignment gently sloping toward the north, or with the trend of the secondary drainage. The mountains and valleys of the western part of the area are higher than those in the east, indicating the direction of the main drainage. The areas of bottom land along even the larger streams are comparatively narrow, and the terraces are limited, forming no distinct feature in the relief of the area. A few small sinks are scattered over the limestone areas.

The elevations vary widely, ranging from 275 feet above sea level at Harpers Ferry to 2,320 feet, the highest point on Cacapon Mountain. The general elevation of the crest of South Mountain is about 1,200 to 1,400 feet above sea level and that of the Shenandoah Valley about 500 to 600 feet. North Mountain ranges from 800 to 1,000 feet north of Hedgesville and from 1,200 to 1,400 feet south of this point. The Back Valley lies about 500 to 600 feet above sea level, and the Sleepy Creek Valley 600 to 900 feet. The intervening Third Hill-Sleepy Creek Mountain is about 1,000 to 1,500 feet high. Warm Spring and Tonoloway Ridges average about 1,000 feet, with knobs rising to 1,200 feet. Cacapon Mountain rises from about 1,000 feet near the Potomac River to 1,545 feet within a few miles and reaches 2,320 feet at the Virginia line. The general level of Cacapon Valley is 600 to 800 feet above sea level. Sideling Hill-Purslane Mountain has a very irregular relief, ranging from 1,000 to 2,000 feet in elevation. The slopes on its west side range from 800 to 900 feet in elevation at the base of the mountain to 600 or 700 feet along the river bluffs.

The area surveyed is drained by the Potomac and Shenandoah Rivers, which unite at Harpers Ferry. The Shenandoah River drains only a small part of the area, receiving the drainage of the southeastern part of Jefferson County. The remainder of the area is drained into the Potomac River through a series of tributaries having separate drainage basins. Opequon Creek drains the valley east of North Mountain, except that a few lateral streams flow directly into the Potomac. Back Creek receives the drainage from the Back Valley, and Sleepy Creek the drainage from the Sleepy Creek Valley, with the exception of that carried by a few smaller streams flowing directly into the Potomac, such as Warm Spring Run and Sir Johns Run. The drainage of "Long Valley" flows into the Cacapon River, and that from the western slope of Purslane Mountain flows through short streams into the Potomac River.

The drainage system has a trellislike arrangement. The smaller streams ramify all parts of the upland except the mountain areas, which have no well-defined stream courses, the drainage flowing down the steep slopes through rocky gulches. The valleys are well watered; there are numerous large springs, especially in the limestone valleys. Practically all parts of the area have good surface drainage. A few small areas in the limestone valley have poor drainage, and along some of the smaller streams for short distances marsh conditions prevail. The Potomac River at Harpers Ferry has an elevation of 275 feet and at Paw Paw, at the other end of the area, an elevation of 500 feet, giving a fall of 225 feet in about 100 miles, or about $2\frac{1}{4}$ feet per mile. There are only a few rapids and no abrupt falls. The Shenandoah River drops about 85 feet between

the Virginia line and Harpers Ferry, a distance of about 20 miles. The streams in general in the limestone valley have cut down about 100 feet below the general level of the valley. In the shale valleys west of North Mountain the streams have cut about 200 feet below the level of the valleys and 300 to 400 feet below the level of the minor ridges. Although the larger streams have cut well down toward base level, they do not have sluggish currents. The drop is still sufficient to give impetus to the currents, especially in the small streams of the shale valleys. The streams of the limestone region have cut nearer to base level than those of the shale valleys, many having reached a temporary base level. Some of the streams of the shale valleys have reached local base levels, their beds encountering hard sandstone strata. This is typically exemplified in Sir Johns Run, Warm Spring Run, and Meadow Branch. These streams have sluggish currents through most of their courses, and make a rapid descent near the entrance to other streams. Large waterpower developments are located on the Shenandoah River near Keys Ferry and on the Cacapon River near Great Cacapon. Several dams are located along the Potomac River, and used in connection with the lock system of the Chesapeake & Ohio Canal. Many mills are found along the smaller streams where they break from the general level of the upland to the larger streams. The drops, however, are not great, the volume of water is small, and the power development limited. These streams are used in a few cases to run flour and corn mills that have been in operation for over a century. The most notable of these mills are those at Bedington, Bunker Hill, Millville, and Kabletown.

This area is a part of a section originally granted to certain noblemen by the King of England. It fell into the hands of the Fairfax family, was surveyed in 1747, and was afterwards known as the Fairfax grant. Owing to certain litigation involving possession of this land, early settlement and development were retarded. The first permanent settlements were made by Germans about 1730, in the northeastern end of the valley. A colony of Scotch and Irish settled on Apple Pie Ridge about 1732. These came from Pennsylvania, as did most of the settlers in the northern end of the valley. The southern end was settled by immigrants from Virginia, largely of English extraction. Settlement began in the Shenandoah Valley, and later spread to the "back valleys," as the shale valleys west of North Mountain were called. Indian depredations retarded the settlement of the area to some extent, and it was not until after the defeat of the Indians at Point Pleasant that this danger was entirely removed. Following the Revolutionary War, the Fairfax quit-rent system was abolished by act of Congress, and the section began to

develop very rapidly. Berkeley County was formed from Frederick County, Va., is 1772; Jefferson County was separated from Berkeley County in 1801; and Morgan County was formed from the western part of Berkeley County and the northern part of Hampshire County in 1820. All three counties were formed before West Virginia became a State. Shepherdstown, founded in 1762, is one of the oldest towns in the State. Other towns of this section were founded somewhat later—Martinsburg about 1772 and Charles Town about 1786.

The Chesapeake & Ohio Canal and the Baltimore & Ohio Railroad were epoch-making projects in the development of the area. Both were begun in 1828. The railroad reached Harpers Ferry first, and was soon extended to Cumberland. The Chesapeake & Ohio Canal reached Harpers Ferry in 1840. Water was turned into the head of the canal in 1850. A branch of the Baltimore & Ohio was built from Winchester to connect with the main line at Harpers Ferry in 1840. What is now the Norfolk & Western Railway, passing through Jefferson County in a north and south direction, was built in 1872. The Cumberland Valley Railroad was constructed about the same time to Martinsburg, and extended to Winchester about 1887. This road passes through Berkeley County north and south. The period from about 1830 to 1840 was known as "the turnpike era," and many surfaced pikes were built throughout the limestone-valley section.

The present population is descended largely from the original settlers. A large number of negroes are found in the southern part of Berkeley and Jefferson Counties, who are descended from the slaves owned by the operators of large plantations in that section. A few Italians are employed in the quarries. The Shenandoah Valley section is the most densely populated, containing the larger towns and a large proportion of the industrial population. Most of the population of the area is engaged in agricultural pursuits and allied industries. The shale valleys are sparsely settled, and on the mountains there are only a few isolated cabins. The population by counties, as reported by the 1910 census, is as follows:

Urban and rural population of Jefferson, Berkeley, and Morgan Counties, 1910.

County.	Urban.	Rural.		Total population.
		Total.	Per square mile.	
Jefferson	2,662	13,227	62.7	15,889
Berkeley	10,698	11,301	34.8	21,999
Morgan	0	7,848	33.7	7,848

Martinsburg is the largest and most important town in the area, having a population in 1910 of 10,698. It is the county seat of Berkeley County, is located on the main line of the Baltimore & Ohio Railroad and the Cumberland Valley Railroad, and is a manufacturing center of importance. It also is the center of the Berkeley County apple industry and one of the largest shipping points for apples in the East. It is the trading point of a rich agricultural section. There are no other towns of importance in Berkeley County.

Charles Town, the county seat of Jefferson County, is the next largest town in the area. It is situated near the center of the county on a branch of the Baltimore & Ohio and on the Norfolk & Western. It has a population of 2,662 according to the 1910 census, is the center of a rich agricultural section, and also has some manufacturing development. Shepherdstown, with a population of 1,070 in 1910, is situated in the northern part of Jefferson County on the Norfolk & Western and the Potomac River. It is an educational center. Harpers Ferry is located at the juncture of the Potomac and Shenandoah Rivers. It is a town of historic interest and a summer resort famed for its scenic features. Harpers Ferry and the adjacent town of Bolivar have a total population of 1,453 according to the 1910 census. Shenandoah Junction, where the Baltimore & Ohio and Norfolk & Western cross, is a small town of about 350 population.

Berkeley Springs, the county seat of Morgan County, had a population of 864 in 1910, but has grown rapidly since that time. It is a health resort of some note, owing to its warm springs, which have a recognized medicinal value. It is the center of the canning industry of Morgan County, and has other small manufacturing interests. Paw Paw, with a population of 725, is located in the southwestern corner of the county, and is the site of a large tannery. Great Cacapon, with a population of about 300, is located at the mouth of the Cacapon River and is the center of the timber industry of this section.

The main line of transportation for these three counties is the Baltimore & Ohio Railroad, which is a double-track road, passing through the area east and west a distance of about 75 miles. A branch of this road extends from Harpers Ferry through Charles Town to Winchester, in the adjoining county to the south. A short branch extends from Brosius to Berkeley Springs, a distance of 6 miles. The Norfolk & Western passes through Shepherdstown and Charles Town, and the Cumberland Valley Railroad through Martinsburg and numerous small stations in both ends of the county. The Western Maryland Railroad extends along the opposite side of the Potomac River from Hancock to opposite Paw Paw, touching Morgan County at several places where it cuts through the big

bends of the river. The Baltimore & Ohio fast-freight line passes through the area, following the general direction of the other tracks, with a few cut-offs to shorten distance. The old Chesapeake & Ohio Canal passes along the Maryland side of the Potomac River from Harpers Ferry to above Paw Paw. This at one time was a heavy carrier of freight, and is still used to some extent, but the faster method of railroad transportation has largely supplanted this system.

The public roads in the limestone-valley section are good, nearly all being surfaced with limestone material and constructed along good grades. The shale valleys have fairly good roads; the road-beds are smooth in fair weather, but they are not constructed on proper grades and are not very well kept. The roads over the mountains are poor. In Berkeley County the toll system is in use along the valley pikes. Jefferson County has no tollgates, and practically all the roads are macadam, but some of these are becoming badly worn for lack of proper surfacing material. In most of the valley sections of the area telephones are in general use.

Of the early industries, iron production was the most important. The Germans began the operation of iron furnaces about 1780, and a number of furnaces were operated successfully in different parts of the area until the opening of the Pennsylvania fields. A few continued until 1880. Paper mills began operation about 1850, and some are still in operation. Halltown is the center of the paper industry. A large number of limestone quarries are operated in the area, most of them in the vicinity of Martinsburg. The greater part of the output is crushed and shipped to Pennsylvania for use as flux in the manufacture of iron and steel. The limestone is also used extensively for road material, as building stone, and for making cement and lime for building and agricultural purposes. The shale beds are used in many places for the manufacture of brick. In the vicinity of Berkeley Springs large sand quarries are operated. The crushed sand is used in the manufacture of glass and for building purposes.

The towns within the area furnish fairly good markets for agricultural products. The most important of these is Martinsburg. The mining towns of West Virginia and Pennsylvania also furnish good markets for farm and garden produce. Harrisburg, Washington, and Baltimore are the largest outside markets. Supplies are purchased mainly at Baltimore.

CLIMATE.

The climate of the Jefferson, Berkeley, and Morgan Counties area is healthful and generally pleasant. The summers are warm but not excessively hot, and the winters are such as are generally known in

the North as "open winters." The weather is usually mild until about Christmas, but severe weather is often experienced in January, February, and early March.

The Blue Ridge Mountains along the east protect the area from the damp winds and fogs from the Atlantic Ocean, while the successive high mountain ranges in the western part of the area afford some protection from the cold waves from the northwest. These mountains to some extent serve to check the cool winds of the summer, and the valleys are warmer than might be expected from their latitude and elevation. The valleys in the western half of the area being somewhat higher than the Shenandoah Valley, the temperature ranges a few degrees lower throughout the year, and killing frosts may occur a week earlier in the fall and a week later in the spring. The average date of the first killing frost in the fall is recorded at Martinsburg as October 18 and that of the last in the spring as April 22. This gives an average growing season of about six months. The date of the earliest frost recorded in the fall at Martinsburg is September 23, and of the latest in the spring May 22.

The mean annual precipitation at Martinsburg is about 37 inches. This is well distributed throughout the year; even in the driest years the rainfall is ample in the summer months for growing crops. Climatic records kept at Romney and Moorefield, W. Va., which are more representative of the western part of this area, show the rainfall to be a few inches less than that recorded at Martinsburg. The mean annual snowfall at Martinsburg is about 27 inches.

The climatic conditions of this area are such that general farming, stock raising, dairying, and fruit growing may be followed advantageously.

The following table is compiled from the records of the Weather Bureau station at Martinsburg, and is fairly representative of the climatic conditions of the three counties in the area surveyed:

Normal monthly, seasonal, and annual temperature and precipitation at Martinsburg.

Month.	Temperature.			Precipitation.			
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year (1895).	Total amount for the wettest year (1901).	Snow, average depth.
	°F.	°F.	°F.	*Inches.*	*Inches.*	*Inches.*	*Inches.*
December	32.2	70	− 4	2.60	3.05	5.25	4.5
January	30.1	71	−19	2.40	2.45	1.65	6.1
February	29.7	70	−13	2.40	1.29	.25	9.7
Winter	30.7	71	−19	7.40	6.79	7.15	20.3

Normal monthly, seasonal, and annual temperature and precipitation at Martinsburg—Continued.

Month.	Temperature.			Precipitation.			
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year (1895).	Total amount for the wettest year (1901).	Snow, average depth.
	°F.	°F.	°F.	*Inches.*	*Inches.*	*Inches.*	*Inches.*
March	41.3	90	−1	3.28	2.25	3.08	5.7
April	51.2	94	21	2.94	3.93	6.75	.3
May	63.2	98	31	3.41	3.26	8.35	0
Spring	51.9	98	−1	9.63	9.44	18.18	6.0
June	70.7	101	41	4.18	3.07	5.69	0
July	75.4	104	49	4.04	2.78	5.60	0
August	73.0	102	45	3.65	2.25	7.37	0
Summer	73.0	104	41	11.87	8.10	18.66	0
September	66.6	98	31	2.88	1.77	2.10	0
October	54.3	90	23	2.59	1.38	.55	T.
November	42.9	79	6	2.20	1.50	3.72	1.0
Fall	54.6	98	6	7.67	4.65	6.37	1.0
Year	52.5	104	−19	36.57	28.98	50.36	27.3

AGRICULTURE.

Agricultural development began in the Shenandoah Valley soon after the first permanent settlements were made. Early settlers grew crops in a small way for home consumption and to supply immigrants moving farther west. Skins and furs were used for some time as a medium of exchange for salt and iron. Prior to the Revolutionary War such crops as wheat, corn, rye, flax, oats, and potatoes were grown. Tobacco was introduced by Virginia planters some time before the Revolution, but it was not planted extensively until about 1776, when the acreage in wheat was considerably reduced, owing to the injury to the crop caused by the Hessian fly. Tobacco soon became the leading crop. It was planted on new land and grown for several years before the fields were planted to other crops. It continued to be the leading crop until the high prices resulting from the food shortage caused by the French Revolution encouraged a return to wheat production. Many of the farmers, especially the Germans, considered corn too exhaustive to the soil and sowed wheat. Wheat, therefore, became the principal crop of the valley section and has continued as the leading crop until the present time. Before the construction of the Baltimore & Ohio Railroad and the opening of the

Chesapeake & Ohio Canal the products of the farms were carried by pack trains to Georgetown, D. C., and Alexandria, Va., the principal markets for this section at that time. The early settlers found stock raising more profitable than the production of crops for market, as the stock could be more easily transported. Large numbers of horses, cattle, sheep, and hogs were raised. Following the introduction of rail transportation, large quantities of wheat were grown and shipped to Baltimore and Richmond or made into flour. The production of wheat has not been affected by the large production in the Western States. The agricultural development of this area progressed steadily until the beginning of the Civil War. During this war the Shenandoah Valley was the scene of continual war operations, resulting in heavy losses from which it required many years to recover.

The land of the Shenandoah Valley has been under cultivation since the early settlement of the area, and yields are reported to have been consistently good. Many of the large farms that were operated by slaves before the Civil War have been rented. Some of the renters hold the farms under long leases, and take good care of them, but many of the tenanted farms are in a run-down condition. Guano was introduced about 50 years ago and, judging from census reports, fertilizers were in general use by 1879. Liming has been practiced for 25 or 30 years, but the use of lime did not become general until recent years. Many of the farms have been cropped severely, and only where large live-stock interests or dairies have been developed has there been sufficient manure used. The agricultural development of the shale valleys is more recent than that of the limestone valleys. Farming on the shale soils has been more successful since the introduction of commercial fertilizers. However, in some of the remote sections of the shale valleys some of the farms are being abandoned and the farmers are moving nearer to the railroads.

The census reports from 1880 to 1910 indicate that there has been very little change in the acreage or production of the leading crops in the area in that time. In general, wheat shows a slight decrease from 1880 to 1910 and corn a slight advance during that time. Oats, rye, and buckwheat show a marked decline, while hay and potatoes show a decided increase. Orchard products show a great advance. Animal products show a considerable increase from 1900 to 1910, due partially to the advance in prices of animal products.

At the present time the agriculture of the area consists of the production of general farm crops, stock raising, dairy farming, market gardening, and orcharding. The principal field crops grown are wheat, corn, and hay. Oats, rye, buckwheat, potatoes, and tomatoes constitute the minor crops.

The following table gives the acreage and yield of the various field crops in 1909 by counties:

Acreage and yield of principal crops, 1910 census.

Crop.	Jefferson County.		Berkeley County.		Morgan County.		Total.	
	Acres.	Bushels.	Acres.	Bushels.	Acres.	Bushels.	Acres.	Bushels.
Wheat	29,567	522,512	23,893	358,914	3,899	42,872	57,359	924,298
Corn	20,465	635,697	20,784	523,101	7,656	151,054	48,905	1,309,852
Rye	421	4,247	1,874	18,650	2,368	22,399	4,663	45,296
Oats	438	8,599	977	16,681	1,286	22,724	2,701	48,004
Buckwheat	.....	.....	17	192	783	10,883	800	11,075
Potatoes	362	36,551	452	42,598	294	31,691	1,108	110,840
Other vegetables	425	.....	500	.....	1,631	.....	2,556	.....
		Tons.		*Tons.*		*Tons.*		*Tons.*
Hay	10,737	11,204	12,099	11,710	2,683	2,568	25,519	25,482

Wheat occupies the largest acreage of any crop in the area, and is the principal money crop. The greater part of the wheat is grown in the Shenandoah Valley section. A part of the crop is used by local mills, and the remainder is shipped out of the area, mainly to Baltimore and Richmond. Corn is grown on an acreage slightly less than that of wheat. A large part of this crop is used to feed work stock and fatten stock for market. Hay is the next crop of importance. The hay crop reported in the 1910 census consisted of 15,123 acres of timothy alone, 1,363 acres of clover alone, 8,417 acres of timothy and clover mixed, 149 acres of alfalfa, and 75 acres of millet, with 115 acres of other tame grasses, and 277 acres in wild grasses, grains cut green, and coarse forage. Alfalfa is grown upon a larger acreage at the present time. The hay produced in the area is used for feeding stock and for sale at local markets. Some redtop is substituted for timothy and cowpeas for clover in the shale belt.

The minor crops—rye, oats, and buckwheat—are grown for the most part in the shale valleys. Potatoes are grown almost entirely for home consumption and for local markets. Most of the other vegetables are grown for home use. In the vicinity of Berkeley Springs a large acreage is planted each season to tomatoes; these are used for canning, 75 carloads of canned tomatoes having been shipped from Berkeley Springs last season, and it is estimated that 150 carloads will be shipped from Morgan County in the 1916 season. The tomatoes are usually contracted for by the canneries. The price paid this season (1916) was 30 cents per bushel, and yields of 400 to 500 bushels per acre are generally obtained.

Orcharding forms one of the principal agricultural industries of the area; both apples and peaches are grown on a commercial scale.

The following table shows the apple and peach production of the area by counties:

Number of apple and peach trees and production, Jefferson, Berkeley, and Morgan Counties, 1909.

County.	Apples.		Peaches.	
	Trees.	Bushels.	Trees.	Bushels.
Jefferson	77,537	143,129	6,252	310
Berkeley	166,118	246,508	35,064	11,950
Morgan	64,252	54,438	44,645	26,947
Total	307,907	444,075	85,961	39,207

Apples have been grown for home use since the first settlement of the area, but it was not until about 1895 that they became an important commercial crop. Since that time the development of orcharding has been very rapid in the Shenandoah Valley, and especially upon the low ridge on the western side of the valley in Berkeley County. The 1916 apple crop of Berkeley County is estimated at 350,000 barrels. Most of it classes as fancy fruit, with a value of approximately $1,000,000. This is the largest crop in point of yield, quality, and price that has been grown in the county. Of the apples grown in this section for shipment the Ben Davis variety makes up about one-half and the York Imperial about one-fourth, the remainder consisting of Grimes, Mammoth Black Twig, Winesap, Jonathan, Delicious, and Gano. The largest orchards are found along Apple Pie Ridge in the vicinity of Gerrardstown and Arden, and around Inwood and Tabler. The York Imperial is the dominant variety in these orchards, while the Ben Davis seems to predominate in the orchards of the shale valleys. Varieties that mature in the summer are grown to a small extent; these are mainly the Yellow Transparent, Duchess of Oldenburg, and Red Astrachan. Many apples are sold to cider mills and evaporating houses and fed to swine.[1]

Peaches came into importance as a commercial crop about 1890, and have made rapid progress since that time, especially on the red land of the shale valleys. The total number of peach trees in the area as reported in the census of 1910 is considerably smaller than that reported in the 1900 census, but the yield is much greater. The reason for this is that in the large apple orchards of Berkeley County peach trees were used as fillers, being removed as they passed bearing age or became in the way in the development of the apple

[1] For further information on the orchard industry of the area, see "Orchard Survey of Berkeley and Jefferson Counties, W. Va.," W. Va. Agr. Expt. Sta.

trees. Morgan County has developed large orchards devoted strictly to peaches. About 100 carloads of peaches were shipped from Berkeley County during the season of 1916, and it is estimated that the Morgan County crop is considerably in excess of this, but no accurate data could be obtained. The most popular varieties are the Heath and Elberta. The Early Crawford is grown in the greater part of the Shenandoah Valley orchards. Most of the peach crop is shipped out of the area.

Small fruits are grown almost exclusively for home use. A total of 7,675 grapevines is reported in Morgan County, 3,199 in Berkeley County, and 1,280 in Jefferson County in 1909. Strawberries are grown to some extent in Berkeley and Jefferson Counties, and some raspberries are grown in Berkeley County. On the mountains an abundance of blackberries and huckleberries grow wild.

Stock raising forms an important part of the agricultural activity of the area, especially of the Shenandoah Valley section. The value of live stock and products shows a marked increase in 1910 over that reported in the 1900 census. Horses, cattle, sheep, and hogs are raised on nearly all the farms.

The following table, compiled from the census of 1910, shows the number of animals sold or slaughtered in the area and the live stock on farms and ranges, by counties:

Live stock and products, 1910.

Stock.	Jefferson County.	Berkeley County.	Morgan County.
Domestic animals sold or slaughtered:			
Calves sold or slaughtered	1,042	2,159	322
Other cattle sold or slaughtered	2,683	2,481	690
Horses and mules sold	775	555	92
Swine sold or slaughtered	12,588	9,996	2,876
Sheep and goats sold or slaughtered	6,939	7,995	371
Number in area on farms and ranges:			
Milch cows	3,486	4,165	1,622
Other cattle	5,040	3,989	1,397
Horses	5,816	5,474	1,573
Hogs	15,155	9,970	2,883
Sheep	26,796	19,925	1,223

Colts are raised in sufficient numbers to supply the local demand, with some for shipment. The horses are mainly of the light to medium draft type. Percheron stallions are used. The brood mares are utilized as work stock, and horse raising is an adjunct to regular farming.

Cattle represent the largest live-stock interest. A good many cattle are bred in the area. These consist of Shorthorn, Polled

Angus, and Hereford. Large numbers are brought in from Virginia and West Virginia and fattened for shipment to the eastern markets. Dairying has been developed to some extent near Martinsburg and along the line of the Baltimore & Ohio Railroad. The products are either disposed of locally or shipped to Baltimore and Washington. Milch cows are kept on almost every farm. The Holstein and Jersey are the predominant breeds of dairy cattle.

Large flocks of sheep are kept on some of the limestone-valley farms. Sheep were kept at one time in large numbers for the wool, but the high price of mutton and lamb of late years has caused the introduction of large numbers of Shropshire sheep. Hogs are raised to supply the home and local markets. The principal breeds are the Berkshire, Poland China, and Duroc Jersey.

The following table gives, by counties, the relative values of the various classes of agricultural products of the area:

Value of agricultural products, 1910 census.

Product.	Morgan County.	Berkeley County.	Jefferson County.
	Dollars.	*Dollars.*	*Dollars.*
Cereals	181,136	737,866	940,410
Other grains and seeds	233	1,111	2,607
Hay and forage	32,069	146,694	139,882
Vegetables	87,529	71,941	62,407
Fruits and nuts	70,384	205,792	94,238
All other crops	47,624	67,851	25,722
Live stock and products:			
Animals sold or slaughtered	74,005	350,340	396,245
Dairy products, excluding home use	18,758	87,701	52,826
Poultry and eggs	42,052	131,869	104,873
Wool, mohair, and goat hair	829	13,385	20,211
Total value	554,619	1,814,550	1,839,421

Agriculturally the area is divided into three parts, based upon physiography—the limestone valley, shale valleys, and the mountain sections. The three divisions have marked differences in topography and soil. The limestone-valley soils are the strongest and support the best developed agriculture. The soils of the shale valleys are lighter, have a more uneven surface, and are less well suited to agricultural operations. The mountain section is classed as nonagricultural on account of its generally unfavorable soil and steep, broken topography.

The farmers in general recognize the limestone-valley soils to be the best adapted to the production of such general farm crops as wheat, corn, oats, and hay (timothy, clover, and alfalfa). The shale land is considered better suited to rye and buckwheat. The bottom

lands, especially those of the limestone valley, are considered the best corn land. The terrace areas are recognized as good rye, oats, potato, and corn land. The lighter limestone soils occupying the ridges are recognized as the best for apples and the red land of the shale valley as best suited to peaches. The production of the various crops is not restricted to the soils that are generally recognized to give the best returns, but, as a rule, they have the best development. Nearly all the crops are grown more or less upon all the soils.

The methods of farming in the limestone region differ somewhat from those employed in the shale region. In the limestone valley wherever general farming is practiced some live stock is kept and a small orchard is maintained. Wheat is grown two years in the rotation, corn one, and grass two. The surplus products are sold. Where stock raising or dairying is practiced wheat is grown only one year and corn and hay two years. Some land is usually kept in pasture. The crops are fed to live stock, and the stock or products are sold. In the large orchards the land is usually tilled, following the general plan of farming, but it is handled with a view to the best results with the orchard rather than with the crops. The orchards are devoted mainly to apples. On many of the farms either some form of stock raising or orcharding is the major industry, and general farming is subordinated. In the shale valleys general farming, orcharding, or truck growing is followed, with little attention given to live stock. Where general farming is practiced some stock is usually kept. Wheat and hay are grown to a much smaller extent than in the limestone valley, and oats, rye, barley, and buckwheat take the place of wheat in the rotations. Buckwheat is grown extensively in the orchards. Peach orchards predominate, with some apple orchards. Tomatoes are grown extensively in the shale valleys. Here redtop and cowpeas sometimes take the place occupied by timothy and clover in the limestone valley rotations.

In general farm practice land is prepared for corn by plowing to a depth of 6 to 8 inches and harrowing. Sometimes the plowing is done in the winter months and the soil left to be pulverized by the action of the weather. Corn is usually cultivated three to five times, depending on the season. Wheat and timothy are drilled in the corn stubble around the shocks or in a strip along the line of shocks without plowing. The following spring clover is sown in the wheat. The timothy and clover crop is cut for two seasons and then turned under, and the land is planted to corn again. In some cases the fields are used as temporary pastures for a short time before the sod is turned. These pastures do not, however, take the place of the permanent bluegrass pastures that are usually located on bottom land or on stony limestone soil. Where it is desired to put land in

permanent pasture the bluegrass is sown with the timothy, and the pasture comes in as the timothy runs out. In the shale country the native pastures are poor and the stock is maintained on the grassland after mowing is no longer profitable or on woodland. The bottom land also is utilized as pasture. White and Yellow Dent varieties of corn are grown. Except where the corn is cut for ensilage it is left standing in shocks in the field. The acreage in oats is comparatively small and depends to some extent upon the opportunity for spring seeding. Winter oats are not grown to any appreciable extent. In seeding wheat in the shale belt the land often becomes too dry before the operation is finished. In such case, unless the land is moistened again before it is too late to sow the wheat, the fields are left fallow and sowed to oats the following spring. In the shale valleys buckwheat is grown in the orchards and following the first year of wheat in the rotations. Cowpeas are grown for hay and hog pastures to a small extent, usually in the orchards. When the mowing is short millet is often grown as an additional hay crop. The methods of handling orchards vary to some extent. The cultural methods are not very uniform. Until the trees begin to bear they are quite often intercropped with the usual rotations practiced in the different sections. The rows of trees are generally cultivated when the orchard is in grain or grass. When the apple yield begins to pay for the use of the land clean culture is practiced in the better managed orchards until July or August, when a cover crop of clover, cowpeas, or buckwheat is sown, to be plowed under in the fall or early spring. Some of the largest orchards are kept in sod, and the grass-mulch system is used. Peaches, pears, and some early variety of apple are used very often as a filler in the young orchards, being removed when they fail or interfere with the development of the permanent orchard. Practically all the successful apple growers spray at least once with a lime-sulphur mixture for scale during the dormant season. Another spraying with arsenate of lead and lime-sulphur is given soon after the petals fall, and sometimes a second and third spraying with this mixture are made; this at intervals of five and nine weeks after the first. For varieties susceptible to the bitter rot a spraying with arsenate of lead and Bordeaux mixture is often necessary in August. Peaches require spraying with lime-sulphur mixtures for the scale and brown rot. Considerable trouble has been caused by the San Jose scale and by borers. The new wood of apple trees is sometimes attacked by blight, but this does very little damage to the tree. Cedar rust is quite destructive to apples. A State law demands the cutting of cedar trees where the orchard interests are important enough to warrant it. Traction engines and motor trucks are used to some extent in transporting

the orchard products to the railroad stations. Large cold-storage plants are located at Charles Town, Martinsburg, and Berkeley Springs.

One general form of rotation is practiced in this area, with minor variations and substitutions to suit individual conditions. It consists of one year corn; second year winter wheat, followed by rye or cowpeas; third year wheat, with timothy, seeding clover in the spring; fourth and fifth years, timothy and clover hay. In the shale belt wheat is often grown without the timothy and clover, and appears but one year in the rotation. In some cases buckwheat follows the first year wheat, and oats are sowed the following spring. Barley may take the place of wheat in the rotation.

The farm buildings, both the dwellings and outbuildings, in the limestone-valley section are generally large and substantial (see Pl. I, fig. 1). Many of the old homes, barns, and mills are built of limestone. In many cases the barns are modern and are equipped with silos. Over the shale valleys the homes are less pretentious and the barns are not so good. Many of the mountain-side houses are mere cabins. On the limestone-valley farms the fences are nearly all of woven wire, and many old stone fences remain. The farm equipment is good, including adequate work stock of medium heavy draft, manure spreaders, two and three horse turn plows, disk plows, disk harrows, smoothing harrows, sulky and walking cultivators, grain and fertilizer drills, binders, mowing machines, tedders, rakes, and hay loaders. The thrashing is done by itinerant thrashers. Some of the farms in the shale valleys are as well equipped as the farms of the limestone valley, but most of them have much inferior equipment, grading down to the mountain farms, on which modern machinery is not used and where modern methods are seldom practiced. On such farms the plowing is done with one horse, and subsequent cultivation with the hoe, the grain being reaped with the cradle. The commercial orchards of the area as a rule are well equipped with pruning and spraying outfits and adequate means of handling and transporting the fruit.

The expenditure for commercial fertilizer in the area, as reported in the census of 1910, is given in the following table:

Expenditure for fertilizer, 1910 census.

County.	Farms reporting.	Total expenditure.	Expenditure per farm.
Jefferson	655	$50,359	$77
Berkeley	844	43,822	52
Morgan	601	20,155	34

The quantity of fertilizer used has not varied much in the last 30 years, the farms in the limestone valley using slightly less and those of the shale valleys slightly more than that reported in 1880. Most of the fertilizer used is applied to wheat, and is some form of phosphatic fertilizer, usually acid phosphate. About 250 to 350 pounds per acre is applied to wheat or other small grains, and 500 or 600 pounds is sometimes applied to wheat when followed by grass. In the upper part of the shale valleys, where the means of transportation is good, 200 to 250 pounds is used upon wheat and 100 pounds on corn, oats, rye, or buckwheat. Small applications are usually made around young fruit trees. Complete fertilizer is used to some extent by market gardeners near Martinsburg and by the tomato growers of Morgan County. The manure made upon the farms is applied before plowing for corn. In some cases manure is used on vegetables, heavy applications being made.

Liming is in general practice in the area. The lime is usually applied to sod land before turning, once in each rotation. The applications usually vary from 25 to 50 bushels of burnt lime per acre. Some of the lime is burned on the farms in the limestone valley, where comparatively pure limestone outcrops are found, but some of the limestone is too high in magnesium for this purpose. The lime is purchased largely from local commercial concerns. In the shale valleys, where the distance is too great for cheap transportation, little or no lime is used. The use of pulverized limestone is becoming more popular in the limestone-valley districts, where the product can be handled without too great expenditure for transportation.

Labor is scarce, owing to the better prices paid by industrial enterprises located in the area and adjoining territory. These industries pay $1.50 to $2.50 per day for unskilled labor. In the following table the expenditure for farm labor by counties is given:

Expenditure for farm labor, 1910 census.

County.	Farms reporting.	Total expenditure.	Expenditure per farm.
Jefferson	692	$236,470	$342
Berkeley	745	184,291	247
Morgan	459	47,771	104

More labor is employed upon the limestone-valley farms than upon those of the shale valleys. In the southern part of the limestone valley many of the farm laborers are colored, while in the northern part and in the shale valleys they are mainly native-born whites. On the farms reporting no labor the work is done by the owner or

renter and family. In general, laborers receive about $25 to $30 per month with lodging and $18 to $20 per month with board. Where hired by the day and for short periods, $1.50 to $1.75 per day is paid. Apple and peach pickers and packers are paid as much as $2.50 per day.

According to the 1910 census in Jefferson County about 55 per cent, in Berkeley County about 66 per cent, and in Morgan County about 87 per cent of the farms are operated by the owners. Practically all the remainder are operated by tenants, a small percentage being farmed by managers. The limestone valley shows the strongest tendency toward the tenant system. There has been very little change in the area in the last 30 years in this respect. According to the 1910 census there were 860 tenant farmers in the area; of these 680 were share tenants and 166 cash tenants; the remaining 14 rented on the cash and share basis. Where the farms are operated by share tenants the terms of renting vary widely, but in general the half-and-half system is followed. Under this system the owners furnishes the land and the tenant the labor, and each receives one-half the grain and hay and one-half the increase of stock. In addition to his share of the crops and stock, the renter derives a living from the farm and feed for the live stock. Cash rents average about 5 per cent of the value of the land.

The average size of the farms of the area is 130.8 acres, as given by the 1910 census. There are only two farms of more than 1,000 acres in the area—one located in Jefferson and one in Morgan County. There are 905 farms of less than 50 acres, and 465 of these are in Berkeley County. Many large undeveloped tracts are found in the mountain section and shale valleys. Most of the timber of commercial value has been cut from this land.

The following table gives the area in farms and in improved land, as reported in the 1910 census:

Number and size of farms, 1910.

County.	Total number of farms.	Area in farms.	Average size of farms.	Improved land per farm.
		Per cent.	*Acres.*	*Acres.*
Jefferson	836	89.4	144.5	125.3
Berkeley	1,288	76.5	123.6	90.8
Morgan	866	72.2	124.3	55.0

The average value of farm land as reported by the 1910 census is $53.55 per acre in Jefferson County, $29.38 in Berkeley County, and

$10.31 in Morgan County. The value per acre is much higher in the limestone valley than in other parts of the area. The value of the best improved valley farms ranges from $100 to $200 an acre, while some of the orchard land, in well-matured bearing orchards, is valued at as much as $600 an acre. Some of the limestone-valley land, however, can be purchased for $65 to $75 an acre. In the shale valleys improved land has a value of $20 to $40 an acre. Some of the best improved land is held for as much as $100 an acre, and some of the rougher land can be bought for $10 an acre. The mountain land is valued at about $1 to $5 an acre.

SOILS.

The soils of Jefferson, Berkeley, and Morgan Counties belong to three general divisions or soil provinces—the Limestone Valley province, the Appalachian Mountain province, and the River Flood Plains province. The soils of the first two provinces are residual in origin. Those of the Appalachian Mountain province predominate in the western part of the area, and are derived from shale and sandstone, while those of the Limestone Valley province are developed over the eastern half of the area and are derived from limestone of varying degrees of purity. The soils of the River Flood Plains province occur along streams, and consist of old alluvial deposits, or second bottoms, and recent alluvial deposits, or the present flood plains. Rough stony land is a classification which includes the rough and stony areas of the mountains; the soil material is largely derived from sandstone.

The rocks from which the soils of the area are derived are almost wholly sedimentary in origin, consisting of limestone, shale, and sandstone. The areas originally were nearly horizontal, but owing to elevation of the land and subsequent folding the rocks are now inclined at varying angles and occasionally outcrop at the surface in narrow belts. The surface relief varies, depending largely on the resistance offered by the rocks to erosion. In the eastern part of the area, where limestone is the predominating country rock and erosion has been more rapid than elsewhere, the region is lower and less varied than in the adjacent region to the west. In the western part of the area, however, sharp ridges and comparatively narrow valleys, which extend in some cases entirely across the area in a general northeast-southwest direction, follow the belts of upturned hard and soft rocks, respectively.

The soils for convenience of mapping and classification are divided into series, the soils of each series resembling one another in origin, color, mode of formation, and topography and drainage. The series

are divided into soil types, the units of soil mapping, on the basis of texture.

The soils of the Limestone Valley province are composed of the insoluble or less soluble residue of the limestone formations after the calcium and magnesium carbonates have been dissolved and removed through water action. The soil accumulations over limestone formations is usually shallow, but as a rule is deeper than over the associated shales and sandstones. There are five series of soils derived from limestone—the Decatur, Hagerstown, Frederick, Frankstown, and Colbert.

The soils of the Decatur series are red to reddish brown, with deep-red subsoils. They are derived from comparatively pure, bluish-gray crystalline limestone, which is deeply weathered, leaving very few fragments on the surface and few outcrops. In this area only one type is mapped, the clay loam.

The Hagerstown soils have brown surface soils and yellowish-brown to reddish-brown subsoils. They are derived from limestone that is less pure than that giving rise to the Decatur, containing more carbonaceous impurities, chert, calcareous shale, and thin embedded sandstone, but less of these materials than the limestone giving rise to the Frederick or Frankstown soils. The clay loam type is derived from the purest limestone of the formations giving rise to the Hagerstown series, the stony clay loam from the hardest and most resistant strata, and the silt loam from a comparatively pure, soft limestone. The rolling phase of the silt loam is derived from harder limestone, with more chert, shale, and sandstone, which gives rise to the gravel content. The limestone underlying these soils is not very deeply weathered.

The soils of the Frederick series are gray, with a characteristic salmon-colored gradation from the soil to a red, heavy subsoil. They originate from the weathering of impure limestones, which contain cherty limestone, shale, and sandstone. The silt loam comes from the purest of these formations, but even this soil carries some chert fragments. The gravelly loam contains still more chert, shale, and sandstone, while the stony loam is derived from rock which contains some fairly pure beds of limestone, and also considerable shale, chert, limestone, and coarse-grained, hard sandstone. Fragments of the sandstone cover the surface.

The Frankstown series includes yellow to yellowish-brown surface soils, underlain by yellow subsoils. These soils are derived from highly siliceous limestones, calcareous shales, and fine-grained sandstones. The gravelly silt loam contains some cherty gravel, and a quantity of small shale and sandstone fragments. The silt loam is

more deeply weathered, and is derived from a limestone high in magnesium and from soft, yellow, calcareous shales.

The Colbert soils have yellowish-brown to yellow surface soils and yellow to mottled heavy subsoils. They are derived from siliceous limestone, but have been subjected to poor natural-drainage conditions. In this area the Colbert series is represented by a single type, the silt loam.

By far the greater part of the area of the limestone soils is in the valley between North and South Mountains. Here the soils are derived from Cambrian and Ordovician limestones. Other small areas are found to the west of North Mountain. In the north-central part of Back Creek Valley there is an oval-shaped area consisting of a small valley surrounded by low ridges of Oriskany sandstone. The valley is composed of limestones of the Devonian period. A small strip of these limestones flanks the base of both slopes of Cacapon Mountain.

The soils of the Appalachian Mountain province are derived from the weathering of shales and sandstone. These soils are not very deeply weathered, and partially disintegrated material appears in the soil and subsoil as shale and sandstone fragments and gravel. Three series are mapped in this province—the Berks, Dekalb, and Upshur.

The Berks series is derived from the Martinsburg shale, of Ordovician age, which occupies a broad strip through the middle of the Shenandoah Valley and a narrow strip along the eastern base of North Mountain. This is a dark-gray to black fissile shale which weathers to light brown. It is comparatively soft, and has weathered down almost to the level of the limestone soils. The present soil layer, however, is very thin. The Berks series has brown to yellowish-brown soils and yellowish-brown subsoils. The silt loam is derived from shale that is more or less calcareous. It occupies the more nearly level areas and is more deeply weathered than the shale loam type. The shale loam is characterized by the large quantity of small, platy shale fragments present in both soil and subsoil. A terrace phase of the silt loam is mapped.

The soils of the Dekalb series are the most extensive in the area. They have gray surface soils and yellowish-brown subsoils. The shale loam is the dominant type of this series, and covers the greater part of the low hills and valleys west of North Mountain. It is derived from several formations, viz, Chemung, Portage, Genesee, Hamilton, Marcellus, Onondaga, and Harpers shale. The Chemung, Portage, and Genesee are dark-gray to black shales, and the Hamilton, Marcellus, and Onondaga yellow to brown shales, and the Harpers a greenish-gray shale, but all weather into a soil that has a gray or brown surface. The stony loam type is derived from

the Parkhead member of the Portage formation, from the Clinton shales, and from nearly all the shale formations in the area so situated that fragments from the hard, resistant sandstone strata lying above them have been scattered over the surface by gravity. These fragments represent mainly the Weverton sandstone on South Mountain, the Medina sandstone on North Mountain and Cacapon Mountain, the Purslane and Pinkerton sandstone on Sleepy Creek-Third Hill and Sideling Hill-Purslane Mountains. These sandstones also give rise to the areas of Rough stony land. The Dekalb silt loam occupies the more nearly level areas in the shale formations, where the weathering has taken place to sufficient depth to leave the soil fairly free from the partially disintegrated fragments. The Dekalb stony sandy loam is associated with the coarse-grained and noncalcareous portion of the Oriskany sandstone.

The Upshur series has soils that are brown to reddish brown or Indian-red in color, with red to Indian-red subsoils. They are derived from the Catskill formation, which consists of red shale and fine-grained sandstones. The silt loam occupies the more nearly level areas, where weathering has been deep and where the shale predominates. The gravelly silt loam occupies the hillsides and areas of broken topography, where the weathering is not so deep and shale and sandstone gravel remains. The stony silt loam occupies the slopes at the base of the mountains. The upper strata of the parent formation contain some sandstone, and some of the scattered fragments and bowlders contained in the types are derived from the overlying sandstone strata. Small areas of this soil, consisting of narrow strips, occur intermittently along the west side of North Mountain, and other small areas which are derived largely from the Bloomsburg sandstone occur farther west. The Upshur soils occupy a narrow belt along the base of Sleepy Creek-Third Hill Mountain, extending in a broad, fan-shaped sweep around Devils Nose, of the northern end of Third Hill Mountain. They occupy similar positions near Sideling Hill-Purslane and Spring Gap Mountains, and occur also in an elongated oval-shaped area extending from the Virginia State line along both sides of the Middle Fork of Sleepy Creek. The topography of both the Dekalb and Upshur soils is rolling to quite hilly or broken, and the drainage is well established.

The soils of the River Flood Plains province are classed with two groups—the old-alluvial, or terrace, soils, and the recent-alluvial, or first-bottom, soils. The terrace soils are developed along the larger streams and are mapped with the Elk and Holston series.

The Elk series is represented in the area by the gravelly loam type. The soil is gray to yellowish brown and the subsoil is red. The

surface material consists of silt, sand, and gravel. The gravel is quartzite, quartz, and hard sandstone derived from the sandstones of the Appalachian Region. The subsoil is in places residual, being derived from the weathering of the limestone which underlies the shallow deposits.

The Holston series in this group includes one soil type, the silt loam. It has a gray soil and a yellowish-brown subsoil. It is composed of material washed from shale and sandstone soils in which Dekalb material predominates. The type is prevailingly silty, containing relatively small quantities of sand and gravel.

The first-bottom soils occupy the present flood plains of the streams. These soils consist of material brought down in times of flood, and vary in texture to some extent with the mode of deposition. Where deposited by relatively quiet water the soil is inclined to be heavy, while near the streams or where the current is rapid it is sandy and in places gravelly. The first-bottom soils are classed with three series—the Pope, Moshannon, and Huntington. The Pope and Moshannon series occur along the streams west of North Mountain, while the Huntington series is found in the Shenandoah Valley section.

The Pope series is derived from areas of predominantly Dekalb soil. The silt loam is found along the streams deriving most of their wash from shale land, while the fine sandy loam is derived from areas in which sandstone predominates or where the stream current is rapid. The Pope types have brown to yellewish-brown soils and yellowish-brown subsoils, occasionally mottled with drab or yellow.

The Moshannon soils have brown to reddish-brown surface soils and dull-red subsoils. They are derived from Upshur soil material. The silt loam is the only member of this series recognized. It includes small fine sandy areas near the stream edge and where the type includes material from the Upshur series.

The Huntington soils consist of material washed from limestone areas or areas where limestone soils predominate. They have brown to chocolate-brown surface soils and brown to yellowish-brown subsoils. The silt loam is the only type encountered in this area. It occurs along the Potomac and Shenandoah Rivers and along the smaller streams of the limestone valley. Small areas of marl-bottom soil are included with this type. The material of these areas is much darker at the surface, and the subsoil consists of gray to whitish marl. These areas are derived from limestone, and are usually found immediately below springs issuing from such rock.

The following table gives the geological formations outcropping in the area, with the resultant soil types:[1]

[1] Geology taken from the West Virginia Geol. Surv. County Reports, 1916—Jefferson, Berkeley, and Morgan Counties.

Geological formations and resultant soils.

Age.	Formation.	Soil.
Recent	Recent alluvial (first bottom)	Huntington silt loam.
		Moshannon silt loam.
		Pope silt loam.
		Pope fine sandy loam.
	Old alluvial (terrace)	Elk gravelly loam.
		Holston silt loam.
Carboniferous	Pinkerton sandstone	Rough stony land.
	Meyers shale	
	Hedges shale	Dekalb stony loam.
	Purslane sandstone	Rough stony land.
	Rockwell sandstone	
Devonian	Catskill formation (red shale and sandstone)	Upshur silt loam.
		Upshur gravelly silt loam.
		Upshur stony silt loam.
	Hamilton, Marcellus, and Onondaga formations (gray shale and sandstone).	Dekalb shale loam.
		Dekalb silt loam.
	Portage formation (Parkhead sandstone member)	Dekalb stony loam.
	Chemung, Portage, and Genesee shales	Dekalb shale loam.
		Dekalb silt loam.
	Oriskany sandstone	Dekalb stony sandy loam.
	Limestone strata	Frederick stony loam.
	Unconformity (comparatively pure strata)	Hagerstown clay loam.
Silurian	Helderberg limestone	Frederick stony loam.
	Salina limestone	
	Bloomsburg shale and sandstone	Dekalb shale loam.
		Upshur stony silt loam.
	Niagara formation	Dekalb stony loam.
	Clinton shale	
	Medina sandstone	Rough stony land.
Ordovician	Martinsburg shale	Berks shale loam.
		Berks silt loam.
	Chambersburg limestone	Hagerstown silt loam.
	Stones River limestone	Hagerstown clay loam.
	Beekmantown limestone	Hagerstown stony clay loam.
Cambrian	Conococheague limestone	Hagerstown silt loam.
		Hagerstown stony clay loam.
	Ellbrook formation	Frankstown gravelly silt loam.
		Frankstown silt loam.
	Waynesboro formation	Frederick gravelly loam.
		Frankstown silt loam.
		Frederick silt loam.
		Hagerstown silt loam.
		Colbert silt loam.
	Tomstown limestone	Decatur clay loam.
	Antietam sandstone	Dekalb stony loam.
	Harpers shale	Dekalb shale loam.
	Weverton sandstone	Rough stony land.
Algonkian	Catoctin schist	Upshur stony silt loam.

In the following table the name and actual and relative extent of each soil type mapped in the area is given:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Hagerstown silt loam	24,832	17.7	Hagerstown stony clay loam	6,720	1.4
Rolling phase	62,336		Pope silt loam	6,464	1.3
Dekalb shale loam	83,584	17.0	Dekalb stony sandy loam	3,328	1.1
Rough stony land	54,144	11.0	Deep phase	2,240	
Dekalb stony loam	34,688	7.1	Frederick silt loam	5,504	1.1
Frankstown silt loam	30,912	6.3	Decatur clay loam	4,992	1.0
Berks shale loam	30,848	6.3	Elk gravelly loam	3,968	.8
Hagerstown clay loam	29,248	5.9	Dekalb silt loam	3,776	.8
Upshur gravelly silt loam	25,344	5.2	Upshur silt loam	3,584	.7
Huntington silt loam	16,128	3.3	Frederick gravelly loam	2,496	.5
Frankstown gravelly silt loam	12,480	2.5	Moshannon silt loam	2,496	.5
Upshur stony silt loam	11,392	2.3	Pope fine sandy loam	2,048	.4
Berks silt loam	9,920	2.2	Colbert silt loam	960	.2
Terrace phase	1,088				
Frederick stony loam	8,384	1.7	Total	492,160	
Holston silt loam	8,256	1.7			

DECATUR CLAY LOAM.

The soil of the Decatur clay loam is a red to reddish-brown, mellow clay loam, about 8 inches deep. The subsoil consists of a red heavy clay. Both soil and subsoil are friable when dry, but sticky, plastic, and tenacious when wet. Occasional outcrops of massive blue limestone occur throughout the type, and near these outcrops the soil is much heavier, the surface material often consisting of clay. With the exception of the limestone outcrops, which are relatively few, there are no stones on the surface.

The Decatur clay loam extends in a broad strip in a general northeast-and-southwest direction through the eastern part of the Shenandoah Valley. The bottom land of the Shenandoah River for many miles forms the eastern boundary of the soil. The topography is gently rolling to undulating, forming the low hills of the eastern Shenandoah Valley. Owing to the rolling character of the surface, the type is naturally well drained. Small streams tributary to the Shenandoah and Potomac Rivers pass through this type and rapidly remove the surface water. Occasional slopes have been denuded of the loose soil covering, exposing the clay, but excessive erosion rarely occurs.

This soil is of residual origin, being derived from the weathering of pure massive blue limestone. It is left as a residue after the removal by water of the soluble constituents which make up a large part of the rock. Weathering extends to a great depth, and only a few of the harder, more resistant ledges of limestone protrude.

The Decatur clay loam is considered the best soil for grain and grass in the Shenandoah Valley, and is naturally very productive. It is easily worked when it contains a moderate amount of moisture; when dry it bakes and cracks, and while in this condition it is extremely difficult to cultivate. Nearly all the type is cleared and under cultivation. The farmers in general are in a prosperous condition, judging from the buildings and equipment, which compare favorably with those of the other valley farms. Lime is used to a small extent, and its use is being extended. Commercial fertilizers are used to a less extent than on other valley types. Of the crops grown wheat has the largest acreage and corn ranks second. The hay crop consists of timothy, clover, and some alfalfa. Oats and buckwheat are grown to a smaller extent. Probably 20 per cent of the type is in bluegrass pasture. There are several apple orchards, which appear to do fairly well, but this soil is not utilized for orcharding to as great extent as the lighter valley soils. Some good stock farms are located on this land.

Crop yields are usually high except in the heavier or eroded areas where the raw clay is exposed. Corn yields 40 to 60 bushels per acre. Wheat yields 18 to 25 bushels, with occasional yields of 30 or 35 bushels. Heavy yields of timothy and clover hay are obtained, ranging from 1 ton to 2½ tons per acre. Alfalfa makes even better yields, producing from 3½ to 4 tons per acre per season. Bluegrass grows luxuriantly and furnishes excellent pasturage.

The practice of fall plowing would be beneficial to this soil, as the alternate freezing and thawing of the upturned earth would be highly advantageous, particularly where spring seeding is to be made, as the soil remains cold until late in the spring. Sod land or cover crops should be turned under at frequent intervals to increase the organic-matter content and maintain the productiveness of the soil. Liming should be practiced systematically, with the application of about 1,000 to 1,500 pounds of burnt lime every 4 or 5 years. Where properly handled this soil needs very little commercial fertilizer. However, small quantities of acid phosphate or bone meal are beneficial to wheat. Alfalfa is a crop that is well suited to this soil and that might profitably be extended. Apple growing apparently is not to be encouraged, as the trees do not seem to thrive as on the other valley soils. Wheat can be grown twice in the rotation. The type is particularly suited to grass and clover. This soil is better adapted to crops that do not have to be cultivated than to intertilled crops.

HAGERSTOWN STONY CLAY LOAM.

The surface soil of the Hagerstown stony clay loam consists of 6 to 8 inches of light-brown or yellowish to reddish-brown heavy loam

to clay loam and is underlain by heavier material which grades at rather shallow depths into the reddish-brown clay characteristic of the series. The stone content consists almost entirely of limestone ledges and outcrops, though some loose fragments of limestone and chert occur. Most of these fragments have been gathered and built into walls. In places the rocks on the surface are so large and so numerous that the type might have been mapped as Rough stony land, but for the fact that all limestone land has a comparatively high agricultural value. The very rocky areas are indicated on the map by outcrop symbols, and where the ledges are not sufficiently numerous to interfere seriously with cultivation they are included with the Hagerstown clay loam and the outcrop symbol is used.

This soil occupies the rougher and more hilly parts of the limestone valley, quite frequently occurring along the streams and drainage ways and on slopes where erosion has carried off the products of rock weathering at a rapid rate. The largest areas are in the northeastern and north-central parts of the valley section of Berkeley County. All the type has good drainage.

Though some of the less rocky patches in this soil are farmed to the usual crops and produce good yields, a large part of the type is in open woods and bluegrass pasture. The grass grows even very near the rock ledges, where the soil is thin, and the sod is so dense that other vegetation can get but little foothold. (See Pl. II, fig. 1.) Some of the pastures are very old, and it is on these rougher areas that the raising of beef cattle and sheep is of most importance. Scattered trees and clumps of trees are characteristic of these pastures and furnish plenty of shade for the stock. White oak, red oak, hickory, and locust, with some walnut, make up most of the groves. A part of the type is used for orchards, and where the land is not too rough apples can be grown profitably, though the rocks often make tillage almost impossible. Corn is said to give heavy yields where land of these old pastures is broken.

On account of its value as pasture, little of this type can be bought for less than $45 an acre. Forming, as it generally does, only a part of the farm, the price usually is higher. Good pasture land conveniently located rents for $3 an acre.

The practice of putting the tillable pastures through a rotation once in every 10 or 15 years would probably be beneficial by preventing them from becoming too compact and sod bound.

HAGERSTOWN SILT LOAM.

The Hagerstown silt loam as typically developed has a surface soil of brown, mellow silt loam about 8 to 12 inches deep, containing a few scattered fragments of limestone and chert. The subsoil is slightly lighter in color than the soil, consisting of a brown or

58833

FIG. 1.—TYPICAL LIMESTONE VALLEY FARM BUILDINGS ON HAGERSTOWN CLAY LOAM.

58831

FIG. 2.—WHEAT ON HAGERSTOWN SILT LOAM.

Note smooth topography. Rolling phase in background.

S8830

FIG. 1.—VIEW IN THE LIMESTONE VALLEY.

Hagerstown stony clay loam in foreground, silt loam in wheat field, and rolling phase of silt loam in background.

S8836

FIG. 2.—APPLE ORCHARD ON BERKS SILT LOAM.

yellowish-brown heavy silt loam, which is friable and only slightly compact in structure. Loose rock and ledges of the parent limestone are encountered at varying depths below about 24 inches.

This soil occupies low places or long, narrow, swalelike areas. The rock from which it is derived is comparatively pure limestone, which has weathered more rapidly than the limestone of other parts of the valley. Some of the soil, however, represents material which has been washed in or gravitated to its lower position from the more rolling Hagerstown soils. Occasionally rock outcrops occur in or along the edges of this soil, representing the hard, resistant strata of limestone. These are shown on the map by symbols.

The largest and most typical areas of this soil are found north from Martinsburg to Prospect Hill, around Tabler, and near Van Clevesville. These areas are rather irregular in shape, as are many of the smaller areas scattered over the limestone valley. In Jefferson County this type occupies a regular position in long, narrow, shallow valleys running northeast and southwest, some of the areas continuing almost entirely across the county.

The topography is fairly level to gently undulating or gently sloping, the type occupying swales or low places very often sloping gently toward the center. The surface drainage is not very well established; the type in many places receives drainage water from the surrounding types. The deficiency in surface drainage, however, is offset by the thorough underdrainage, the water passing through the limestone into subterranean channels. Many sink holes occur in this type, and stream heads and springs are common.

Nearly all of this type has been cleared of its original timber, which consisted of an unusually heavy hardwood growth. It is one of the most important soils in the area from an agricultural standpoint, practically all of it being devoted to general farming, stock raising, and dairying. Corn is the most important crop, although wheat and hay cover a large acreage. (See Pl. I, fig. 2, and Pl. II, fig. 1.) Timothy, clover, and alfalfa are grown for hay. Very little of this soil is in pasture, as it is highly prized for cultivated crops. There is some orchard development near Tabler and in the northern part of Berkeley County, but as a rule the type is not extensively used for fruit production. Dairying is practiced more extensively on this soil than on any other in the area. The dairies are located in the vicinity of Martinsburg, Charles Town, and Shepherdstown, and at points near the main line of the Baltimore & Ohio.

Crop yields on this type probably average higher than on any other soil in the area. This is due both to the natural productiveness of the type and to the advanced methods of farming commonly practiced. Corn makes better yields than on any of the upland soils

of the area, the best land producing 40 to 70 bushels per acre. Wheat yields 20 to 25 bushels per acre, oats 35 to 40 bushels, and hay (timothy and clover) 2 to 3 tons.

The rotation usually followed on the other limestone-valley farms is used on this soil. The farmers have little difficulty in plowing this soil and keeping it in good tilth. The soil is retentive of moisture, and its low position insures an ample supply of moisture for crops even during dry seasons. Lime is used to some extent, but manure and fertilizer are not used as extensively as upon some of the other valley types. Little ponds which can not be drained occur in many places, and these are usually fenced in with the pasture and used for watering stock.

Practically all of this type has a value of $100 or more an acre. The methods followed on the best farms are probably as good as could be used on this soil. The extension of dairying, with a resulting increase in the quantity of manure applied to the land, is beneficial to the soil. The alfalfa acreage could profitably be extended where stock raising is practiced. It is doubtful whether orcharding should be encouraged on this type so long as large areas of rolling, arable land better suited to fruit culture are available.

Hagerstown silt loam, rolling phase.—The Hagerstown silt loam, rolling phase, is a brown to yellowish-brown, mellow silt loam about 8 to 10 inches deep, underlain by a yellowish-brown silty clay loam or dull-red clay loam to clay, which is fairly compact and friable. Both soil and subsoil in places contain a relatively high percentage of small fragments of limestone, chert, and shale. Loose limestone rock and ledges are often encountered within the 3-foot profile, and outcropping ledges are numerous. The larger areas of these stones are shown by symbols on the map. This soil is derived from limestone and interbedded calcareous shale. The shale and limestone are of a more resistant nature than the rocks from which the main type is derived.

This soil is found in the limestone valley, occupying elongated low ridges, which occur in a group in the western part of the valley extending from a few miles southwest of Bunker Hill to the Potomac River, and in another group covering the western half of Jefferson County. The topography is gently rolling to ridgy, and the surface drainage is good. (See Pl. II, fig. 1.) However, the subsoil is heavy enough to retain sufficient moisture to supply the ordinary needs of growing crops.

This phase is cleared of nearly all its timber and is utilized for farming. It is one of the most important soils in the area for general farming, stock raising, dairying, and orcharding. The original forest consisted of a heavy growth of oak, hickory, walnut, sycamore, and

a scattering of other hardwood trees. Timber at the present time is confined to woodlots.

The general farm crops grown are corn, wheat, hay (timothy and clover), and oats. Timothy and clover are probably grown on a larger acreage on this than on any other soil. Alfalfa is grown to a small extent. The phase is used for dairying near Charles Town and points along the Baltimore & Ohio Railroad, and to some extent for orcharding in Berkeley County. The rest of the phase is used for general farming and stock raising. Polled Angus is the prevailing type of beef cattle, although there are some Hereford herds. Sheep are kept by some of the farmers of Jefferson County.

Excepting the lower areas of the main type, the yields obtained on this phase are as good as on any upland soil in the area surveyed. Corn yields 40 to 50 bushels per acre, wheat 20 to 25 bushels, oats 30 to 40 bushels, and hay 1½ to 2½ tons.

Probably more lime, manure, and fertilizer per acre are used than on any soil in the limestone valley. This soil is easily cultivated and kept in good tilth. There is not enough rock on the surface seriously to interfere with the use of improved labor-saving machinery, and modern implements are used in many cases. On some of the rented farms the soil has become run down. These farms lack organic matter, and this deficiency makes the soil harder to handle, requiring more tillage to put it in proper condition for seeding.

The price of this land ranges a little lower than that of the lower lying areas of the main type. It is desirable land for farming and orcharding, and is held at $75 to $100 an acre. Some of the better improved farms and some of the orchard land is held at a much higher price, ranging up to $250 to $300 an acre.

On the farms that are run down, the incorporation of organic matter, by turning sod land or plowing under cover crops, would increase the productiveness of the soil and make it easier to handle. Where this is done and the soil is heavily limed the use of commercial fertilizers can be curtailed to some extent. However, it is advisable to use acid phosphate or bone meal with all cereals, making heavy applications when they are to be followed by grass. Apple orcharding and the growing of alfalfa might profitably be extended. The extension of dairying also should prove profitable. The keeping of live stock, with the proper use of the manure, is highly beneficial to the soil. Tobacco is grown extensively and successfully on this soil in Pennsylvania.

HAGERSTOWN CLAY LOAM.

The Hagerstown clay loam in its typical development is a brown to reddish-brown heavy loam or silty clay loam to a depth of about 4 to 8 inches. The subsoil is a brown, reddish-brown, or reddish,

friable clay, which grades into a reddish-brown, stiff clay at about 18 inches. Every field of this type has a more or less spotted appearance, owing to the occurrence of numerous patches of reddish clay; the intervening areas may be silt loam of a duller brown color. These silt loam areas occur in the depressions and on the very gentle slopes and have a depth of 10 to 15 inches. If of greater extent they would be mapped as the Hagerstown silt loam. Outcrops of massive blue and gray limestone are characteristic of the type; where these are numerous they are indicated on the map by symbols. Surrounding these outcrops the soil is a heavy clay of a deeper red color than usual. The dip of the rock is generally fairly sharp, but in a few small areas the underlying strata are almost flat. In places the soil is shallow. Bordering the shale land are narrow strips of this soil that are much darker brown in both soil and subsoil than the greater part of the type. The limestone giving rise to this soil is quarried in places and used for commercial purposes.

This type seems to be derived from a rather pure limestone, as only occasionally are chert fragments encountered on the surface. As in the case of other limestone types, the soil material is composed of the insoluble residue from the solution and disintegration of the underlying limestone rock. In this solution most of the lime was dissolved and carried away, and as drainage is to a great extent downward through the soil into underground channels, processes of solution and removal of what lime remained have been more complete than in soils where the drainage is more largely through surface run-off. The soil often gives an acid reaction, and is benefited by applications of lime.

Important areas of this type occur along both sides of the shale belt which extends through the valley, though it may occur wherever limestone is found. The soil is most typical in an area along the Winchester & Martinsburg Turnpike through Berkeley County. The topography is undulating to rolling, and is particularly favorable for general farming and orcharding. Drainage is good. Surface drainage channels frequently are not well developed, but surplus water is carried off through small sink holes or cracks in the parent rock to subterranean channels.

For general farming this is the most valuable soil of large extent in the county, and it is almost all under cultivation or in orchards. It was doubtless the first land farmed, as it is said not to have been generally forested when the first settlements in the area were made, though there are now many groves in which white oak, hickory, and other hardwoods make a good growth. The type is used for apples, but not so extensively as some of the other limestone soils. Some of the largest orchards in Berkeley County are located on it, around Tabler and Inwood. The York Imperial seems to be the leading

variety, but other varieties do well. The trees are thrifty, bear early and heavily, and are long-lived. Aside from orcharding, general farming is commonly practiced, with wheat as the money crop, and some beef cattle are raised or finished during the winter. Dairying on this type seems to be of secondary importance. Corn probably averages 50 to 60 bushels per acre; in some cases it is grown twice in the rotation, as this is considered a strong corn soil. Wheat yields 20 to 30 bushels per acre, and is followed by timothy and clover. These grasses take well and are mowed about 3 years before the sod is plowed for corn. Hay yields from 1½ to 2 tons per acre. Timothy generally predominates after the first or second year. Bluegrass comes in naturally, but the land is generally considered too valuable to be left in pasture. This is probably the best alfalfa soil in the area; one field of 9 acres was cut four times, with a total yield of 3¾ tons per acre.

This type is well improved (see Pl. I, fig. 1); the houses are often of massive limestone, and the buildings are generally large, well painted, and kept in good repair.

Most of the farms on this type are held at high prices. Improved land within 3 or 4 miles of Martinsburg has sold for $250 to $300 an acre, but some good farms almost as well located could probably be bought for less than $150 an acre. Very little of this land can be bought for less than $100 an acre.

This type is probably the best farmed in the county. Fall or winter plowing, which insures a good seed bed and promotes early seeding, is commonly practiced. More alfalfa is being sowed every year, and wheat is often restricted to one year in the rotation. The silty spots have a mellower structure and are more easily tilled than the typical clay loam areas. Alfalfa does particularly well in these silty areas. On most of the farms this soil is well handled. Where the soil has been allowed to run down organic matter should be added. This can be done effectively by turning under sod or cover crops. This land is in need of lime. Where manure is used and organic matter supplied there is little need of using commercial fertilizer, except for wheat; acid phosphate or bone meal is beneficial to this crop. Alfalfa could profitably be extended. It is doubtful whether orcharding should be encouraged, as there are many areas of cheaper land that are equally well suited to fruit.

FREDERICK STONY LOAM.

The Frederick stony loam consists of a light-gray to brownish-gray fine sandy loam to silty loam, grading into a heavier yellow loam at about 6 to 8 inches. This becomes still heavier and more compact and grades into a reddish-yellow, light-red, or yellowish-brown friable clay somewhere within the 3-foot section. Angular chert, sand-

stone, and quartzite fragments of varying size are abundant on the surface and are scattered through the soil and subsoil. The surface is sometimes covered with a mass of chert fragments 2 to 4 inches in diameter. Limestone outcrops occur, but are not very common.

This type is derived from the solution of limestone that contained considerable chert and interbedded sandstone. The parent formations are the Oriskany sandstone and the Helderberg and Salina limestones. The type is found chiefly on the well-developed ridges in the Back Creek Valley, known as Wilson and Ferrel Ridges. On both these ridges there are some areas of lighter textured material. The type is found also in a narrow strip between Warm Spring Ridge and Cacapon Mountain, and on a corresponding slope to the west, between the mountain and Tonoloway Ridge. A very narrow strip occurs intermittently along the west side of North Mountain. The topography is rolling to steeply sloping and the drainage is good.

This soil is a less desirable agricultural type than the limestone valley soils or the other Frederick soils, but is used to some extent for farming. General farming, stock raising, and orcharding are practiced. The crops grown are corn, wheat, oats, rye, buckwheat, clover, and timothy. The yields are somewhat lower than on the other Frederick soils. Corn, rye, and buckwheat apparently do better than other crops. The low yields are due in some measure to the methods used. Some thrifty apple orchards are found and peaches of good quality are grown. This land is naturally suited to bluegrass, and some of it is in pasture, cattle and sheep being grazed. Much of this type is rough and stony, the stones being large enough to interfere with cultivation. It is forested with a good growth of red and chestnut oak, walnut, and other hardwoods.

Farm land on this type is held at $25 to $40 an acre. Some of the rougher areas have a very low value, while some of the orchard land is valued at about $100 an acre.

If the large stones are removed, the smaller ones act as a mulch, which saves considerable cultivation and is a decided advantage for fruit trees. The growing of cover crops on this soil is not so important as on the less stony soils. The type probably is best utilized for orcharding. This soil, like the other Frederick soils, is in need of lime.

FREDERICK GRAVELLY LOAM.

The soil of the Frederick gravelly loam as typically developed is a gray, mellow loam to silt loam containing a large quantity of small, cherty gravel. This is underlain at depths of about 8 to 10 inches by a transition zone of yellowish-red, friable clay loam containing a few scattered cherty fragments. The subsoil proper is encountered at about 15 to 20 inches and consists of a red heavy clay, which is

compact and friable and contains a few scattered limestone fragments. The soil is derived from a highly siliceous limestone and shale containing cherty strata. The type as a whole is weathered deep and only occasionally are ledges of hard, resistant limestone found. The soil is fairly uniform.

This soil occurs in irregular, narrow belts along Apple Pie Ridge, and between this ridge and the base of North Mountain from below Hedgesville to within a few miles of the Virginia State line. The topography is gently rolling to ridgy. Both surface drainage and underdrainage are well established. The type is not very extensive and is relatively unimportant in the general agriculture of the area.

Most of this soil is cleared and cultivated to general crops or is in pasture or orchards. The forest growth consists of hardwood and is confined to the steeper parts of the type.

The same crops are grown and to about the same relative extent as on the silt loam type, except that a larger acreage is devoted to orchards. This type is slightly less productive than the silt loam, which has resulted in general farming being abandoned to some extent for orcharding. Upon some of the farms the yields are low because of the little attention paid to farming. However, some of the farms are well cared for and the yields are about the same as on the silt loam type. This soil is well suited to orcharding. Its ridgy occurrence gives good air drainage and the cherty fragments form a soil mulch, saving considerable surface cultivation in the orchards. This type ranks about second to the Frankstown gravelly silt loam as an orchard soil. Bluegrass does well and furnishes good pasturage. The usual crop rotations are followed. The same methods of farming are used as on the Frederick silt loam and the Frankstown gravelly silt loam. Lime and fertilizer are used to a small extent where general farming is practiced. The farms upon which the orchards are located generally use fertilizer.

This land does not have a high value for farming, but as possible orchard sites, and the price at which it is held is higher than the productiveness of the soil would warrant. Under average farm conditions it is held for $65 to $100 an acre. Where it is planted to apple orchards it is valued much higher.

A large part of this soil that is farmed has been allowed to run down. Such land is chiefly deficient in organic matter, which can be supplied by turning under cover crops and sod land. Legumes, such as cowpeas, soy beans, and vetch should be grown in the rotations. Many of the orchards depend to some extent upon the natural mulch of this type, and crops that could easily be produced in the orchards are not grown. Lime should be freely used where sod land has been turned. Commercial fertilizers should be used with exhaustive crops.

FREDERICK SILT LOAM.

The Frederick silt loam consists of 8 to 10 inches of light-gray to yellowish-brown silt loam, underlain by a yellow or reddish-yellow, compact silt loam or silty clay loam which at 12 to 20 inches or more may change to a dull-red, heavy clay, becoming redder with depth. Chert and flinty limestones are typically present on the surface and throughout the soil profile, while in some local spots enough yellowish-white chert chips are present to make the soil gravelly. Outcrops of limestone are common, but probably not so numerous as in the Hagerstown soils. Where present in sufficient quantity to be important they are indicated on the map by rock-outcrop symbols. Plowed land on this type often presents a very spotted appearance, eroded knolls and ridges having a pinkish-red color where the underlying clay is exposed, while the remainder of the type is grayish. The reddish clay sometimes approaches the surface, and in such cases the separation of this type from the Hagerstown is based on the gray or light yellowish brown surface soil and the relatively high chert content, the boundary line often being more or less arbitrary.

This type, like the Hagerstown soils, is derived from limestone but of a less pure nature and with a higher chert content. The topography is generally rolling, the type, where associated with the Hagerstown, occupying the higher elevations and having a decidedly rougher surface. The drainage is very largely through subterranean channels and is everywhere good.

This type, known generally as "flinty limestone land," is quite extensive and important. It occurs largely along the valley east of Apple Pie Ridge and in a few detached areas north of Summit Point in Jefferson County. Though considered not quite so valuable as the darker colored limestone soils, it is quite productive and is generally well improved. General farming, stock raising, and orcharding are practiced, and the crop rotations common to the area are followed. Wheat is generally grown two years in succession and yields average between 15 and 18 bushels per acre. Corn yields range from about 25 to 40 bushels per acre. Clover and grass seem to do well, the yields of hay on the better farms nearly equaling those obtained on the Hagerstown soils. The differences in yield on this soil and on the Hagerstown clay loam are probably not all due to soil differences; this type as a whole has possibly been farmed more continuously to wheat and has been less well fertilized.

Farms of this type without commercial orchards sell for about $75 to $100 an acre; where the land is in orchards the price ranges much higher.

The Frederick silt loam is considered a good apple soil. The prevailing varieties of apples are grown, and while the yields may not quite equal those obtained on the darker colored limestone soils, both the color and quality of the fruit are good. Next to the Frankstown soils this is one of the best fruit soils in the area, and there are a number of large apple orchards in the vicinity of Arden.

In the following table are shown the results of the mechanical analyses of samples of the soil, subsoil, and lower subsoil of the Frederick silt loam:

Mechanical analyses of Frederick silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
221763	Soil	1.9	3.0	1.4	4.6	10.6	65.4	13.2
221764	Subsoil	1.6	3.0	1.6	5.4	14.2	55.2	19.0
221765	Lower subsoil	.6	1.8	.9	3.4	10.4	37.5	45.3

FRANKSTOWN GRAVELLY SILT LOAM.

The surface soil of the Frankstown gravelly silt loam consists of a light-gray to yellowish-gray or light-brown silt loam, ranging in depth from 8 to 12 inches. It is underlain by a subsoil of yellow, slightly heavier silt loam which grades at about 18 to 24 inches into a yellowish-brown or ocherous-yellow, friable clay loam. The soil usually contains about 20 to 40 per cent of small, angular gravel, and small fragments of yellow and gray shale. The subsoil contains about 30 to 60 per cent of yellow and gray shale. The subsoil contains about 30 to 60 per cent of yellow shale. Scattered on the surface and in places through both soil and subsoil are fragments of a light-yellow soapstone, and in places small quantities of cherty limestone fragments. In many places fragments of fine-grained sandstone are present. The rocks from which this soil is derived are found at depths varying from a few inches below the surface to below the 3-foot profile. They consist of siliceous limestone with interbedded more or less calcareous shale, and thin-bedded, fine-grained sandstone.

One of the unfailing characteristics of this soil is the occurrence of the fragments of soapstone rock. This rock is very light in weight and is supposed to be siliceous limestone from which the lime has been dissolved, leaving as a residue the porous yellow rock. Pieces of this yellow stone when broken often show a hard limestone center.

This type occurs on long, narrow, well-defined ridges with rounded crests and steep slopes, standing about 100 feet above the general

level of the valley. The relief affords good surface drainage, and the internal drainage is good.

The largest areas of the Frankstown gravelly silt loam are found in two distinct belts, one in Berkeley County, running parallel with and about 1 mile from the eastern base of North Mountain, and the other in Jefferson County, parallel with and about 3 miles from the western base of South Mountain. These belts consist of low double ridges, separated by a narrow band of limestone soil and extending entirely through the valley, and are broken only by streams that cut through the original formation at irregular intervals. This type is closely associated with the Hagerstown, Frederick, and Decatur soils.

Practically all the type is cleared and under cultivation. General farming is not practiced to the extent that it is on the Hagerstown soils. Large areas are in apple orchards, which are planted to cultivated crops to some extent. The orchard development is more on the Apple Pie Ridge part of the type than on the eastern side of the valley, which supports some orchards, but is used mainly for general farming.

Comparatively large areas of woodland are found in the southeastern part of Jefferson County on this ridge. The forest growth consists of hardwood, chestnut apparently predominating. The forested areas are usually confined to the steeper sides of the ridges.

The general farm crops grown are corn, wheat, buckwheat, oats, and clover and timothy hay. Corn, wheat, and hay occupy the largest acreages. This soil is used very little for pasture, as bluegrass does not seem to hold very well. It is valued as an apple soil, some of the largest and most productive orchards in the area are located on it on Apple Pie Ridge, and the acreage in apple orchards is greater than that in any other crop. The type is considered only fairly well suited to general farming. Corn and wheat do not produce as good yields as on the Hagerstown soils, but the type is much stronger than the Dekalb. Corn yields 25 to 30 bushels per acre, and wheat 15 to 20 bushels. Hay averages about 1 ton per acre, but very little hay is produced. Some alfalfa is grown, but it does not do as well as on the heavier limestone soils. General farming and stock raising are very often subordinate to orcharding. Many of the orchards are owned by nonresidents, and operated by tenants. In such cases they frequently are not well cared for, but where the owner farms the land the buildings and fences are usually in good repair and the farming as a rule is well done. The rotations common to the region are followed. Crops are planted in most of the orchards. Fertilizers and lime are used to some extent. Phosphate fertilizers are applied in liberal quantities, especially on the crops grown in the orchards.

This soil is held at a high price owing to its desirability for orchard sites. Probably very little of the type can be bought for less than $100 an acre. In the southeastern part of Jefferson County some of this soil can be bought for $40 to $60 an acre, owing to its poor transportation facilities and its undeveloped condition. Where the type is in orchards it has an exceptionally high value; some of the bearing orchards are held for as much as $600 an acre.

As an orchard soil this type is highly esteemed. The ridges are so situated that there is excellent air drainage, which is a very important factor in coloring the fruit. The soil is loose and gravelly and is easily kept in good tilth, yet the subsoil is heavy enough to retain moisture well. The gravel acts as a mulch to prevent surface evaporation. Nearly all the apples grown in this section seem to thrive on this soil. The varieties commonly grown and seemingly best adapted to the region are the York Imperial, Baldwin, Ben Davis, Yellow Newtown, and Grimes.

For general farming this soil requires both lime and fertilizer. It is, as a rule, deficient in organic matter, and this should be supplied by turning under sod or cover crops, preferably clover. Such legumes as cowpeas, soy beans, and vetch should be grown in the rotations for building up this soil.

FRANKSTOWN SILT LOAM.

The soil of the Frankstown silt loam is a brown to yellowish-brown, mellow silt loam about 8 to 12 inches deep. The subsoil consists of a yellowish-brown or yellow silt loam or silty clay loam. It is only slightly compact and very friable. The soil contains a few scattered fragments of chert and yellow shale, while the subsoil contains a slightly greater percentage of yellow shale chips. In places at varying depths below 24 inches the beds of partially disintegrated shale and ledges of limestone from which this soil is derived are encountered. Over most of the type the parent rock is weathered to a considerable depth, and the surface is comparatively free from stone. Small areas of the Frankstown gravelly silt loam which can not be shown satisfactorily on the soil map, are included with this type. There are also areas in which the gravel content is much higher than the average for the type, but not high enough to make it a gravelly silt loam. These areas are found in the vicinity of Uvilla, from near the bend of Rattlesnake Run to Flowing Springs Run, occupying rounded knolls and low hills. Small areas of the Hagerstown silt loam are included with the type along the edge, where the formations are more or less mixed.

The Frankstown silt loam occurs in a broad belt, about 2½ to 3 miles wide, extending through Jefferson County in a general north-

east-southwest direction. The western boundary extends from a point about a mile east of Shepherdstown through Duffields, Charles Town, and Rippon. This type is derived from the Ellbrook and Waynesboro limestone formations; which are composed of gray, highly siliceous limestone, with some yellow, calcareous shale seams. Small pieces of soft, yellow rock of the same character as that found on the gravelly silt loam are occasionally present on the surface.

The topography is gently rolling to undulating. The type occupies the low, rolling hills characteristic of the Shenandoah Valley. The drainage is well established. This type is well supplied with springs, and natural drainage ways. The subsoil is sufficiently heavy to hold moisture for the use of growing crops. The forest is hardwood, consisting largely of oak, and is confined to small woodlots.

Nearly all this type is cleared and under cultivation. General farming, stock raising, dairying, and orcharding are practiced more or less successfully. Corn and wheat are the principal crops, and hay ranks third. Timothy, clover, and alfalfa are the hay crops. A considerable acreage is in bluegrass pasture. The largest orchards in Jefferson County are located on this soil, but the orchard development is not as extensive as on the gravelly silt loam in Berkeley County.

The Frankstown silt loam is better adapted to general farming than many of the heavier limestone soils. The loamy nature of the soil makes it easier to handle. It produces 25 to 60 bushels of corn per acre, 15 to 20 bushels of wheat, and 1 ton to 2 tons of clover and timothy hay. Bluegrass grows well and furnishes good pasturage. Alfalfa produces fairly good yields. Apples yield well and the fruit is of good quality and color.

The usual rotations are followed on this type, with corn generally two years. The soil is plowed with a lighter equipment than the heavier soils, and the freedom of the surface from stone permits the use of disk harrows and cultivators. The soil can be cultivated within a wide range of moisture conditions, rarely becoming too dry or too wet for tillage. Lime is used to a small extent. Commercial fertilizer is used more extensively than on any other type in the limestone valley. Occasionally sod land is turned. Only on the dairy farms is an appreciable quantity of manure used.

The average price of this land is about $100 an acre. Some of the highly improved farms near towns or with orchards have a much higher value.

The Frankstown silt loam is well suited to general farming, for which it is mainly used. With the exception of the Huntington soil and areas of the Hagerstown silt loam, it is the best corn soil in the area. By the extension of the dairying industry this natural adaptedness could be taken advantage of and crop yields increased

by the addition of manure. Many parts of the type are deficient in organic matter. This can be supplied by turning under cover crops or sod land. The soil is well suited to the production of legumes and clover, cowpeas, soy beans, and vetch could be grown in the rotation to advantage. Alfalfa could profitably be extended as a hay crop. The soil is well suited to the production of apples, being closely related to the Apple Pie Ridge soils, and orcharding could profitably be increased. Liming is generally needed, and the use of fertilizers is beneficial. However, the use of lime and fertilizer should not be depended upon or substituted for the addition of organic matter in keeping up the productiveness of the soil.

The following table shows the results of the mechanical analyses of samples of the soil and subsoil of the Frankstown silt loam:

Mechanical analyses of Frankstown silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
221743	Soil	1.1	1.4	0.6	3.6	12.3	66.3	14.7
221744	Subsoil	.6	1.2	.6	3.6	11.0	55.3	27.7

COLBERT SILT LOAM.

The Colbert silt loam consists of 8 to 12 inches of rather heavy silt loam of a light-gray or yellowish-gray color, underlain by a compact yellow silt loam which quickly passes into a yellow, plastic clay, sometimes mottled with gray and often becoming olive yellow and very stiff at a depth of 24 inches or more. Small iron concretions are commonly found in the surface soil and subsoil, in some places being much larger and more numerous in the lower depths. The type occurs in level and undulating areas and in depressions generally at a slightly lower level than the surrounding Hagerstown and Frederick soils. It is derived from portions of the Waynesboro limestone formation, and its character is due largely to drainage conditions.

The type is generally but not always poorly drained. The poorly drained areas are sometimes spoken of as "persimmon land." Typical areas were mapped in the valley between Apple Pie Ridge and the base of North Mountain. The areas near Ridgeway and Middleway are for the most part fairly well drained and comparable with the other limestone types. Depressed areas in the Frankstown silt loam are occupied by this soil, but as a rule these are too small to separate on the map.

Where drainage is adequate this type is productive, but it often occurs as only a part of a field. If worked when too wet it becomes

cloddy and refractory. Wheat is somewhat subject to winter injury, and clover does not take well. Orchards on some of the drier areas seem to do well, but the type evidently is not as well suited to fruit production as the better drained limestone soils. Where found in large areas, farm improvements on this soil do not appear to be so good, and crop yields and land values are probably 20 or 25 per cent lower than on the surrounding land. The type seems best suited to grass. Timothy gives heavy yields of hay and bluegrass furnishes good pasturage. Alsike might prove successful, but the drainage conditions are unfavorable for other clovers. Open ditches and tile drains could be used to advantage in the flatter areas. Where the soil is properly drained, limed, and supplied with organic matter the yields of general farm crops should be about as good as those obtained on other limestone land.

BERKS SHALE LOAM.

The Berks shale loam typically is a grayish-brown to brown silt loam to a depth of about 6 to 8 inches. The subsoil is a pale-yellow silt loam which grades quickly into a yellowish-brown or mottled yellow and gray, friable silty clay, extending to the bedded shale, which is reached at 10 to 24 inches below the surface. Scattered over the surface and mixed with the soil and subsoil are large quantities of small, thin, platy shale fragments, composing 15 to 60 per cent of the soil mass. These fragments are dark gray, yellow, and brown and in a few places reddish in color, while in other places they are darker, being almost black. In places where erosion is active the surface soil is shallow. Disintegrated shale beds in places are encountered 6 to 8 inches below the surface, and on the steeper slopes shale outcrop often occurs. In the more nearly level areas weathering is deeper and less shale fragments are found in the surface soil. Small areas of the Berks silt loam are scattered through the more nearly level parts of the type and in places where colluvial material has collected. Much of the shale loam type between the base of North Mountain and Apple Pie Ridge, especially in the vicinity of Gerrardstown, is very dark in color, owing to the dark-gray to black color of the shale outcrop. The greater part of the type is very thin, and in many cultivated fields the rotten shale rock is turned up by the plow.

This is one of the most extensively developed types in the area surveyed. The largest and most typical area of the type occupies a wide strip ranging from 2½ to 3 miles in width and extending along Opequon Creek and north to Williamsport. Small spurs run out from this main area and form narrow strips running in the same general direction as the main body. A narrow strip of the type lies along the eastern base of North Mountain.

The Berks shale loam is derived from the Martinsburg shale formation. This shale is generally darker in color than the rocks giving rise to the Dekalb soils, but some of it is brown, yellow, and gray. Where this shale is dark gray to almost black it is known locally as "black shale."

Near the base of the formation the shale is more or less calcareous, and where the formation comes in contact with the limestone there is a transitional zone known locally as "border land." The soil of this border land is considered better than the remainder of the type. Most of this zone, as well as the calcareous part of the shale, which weathers more rapidly than the remainder of the formation, is mapped with the Berks silt loam.

The topography characteristically is smoothly rolling, with occasional narrow but shallow stream valleys having steep slopes. The general elevation of the type is about 500 feet above sea level and the streams have cut valleys to an average depth of about 100 feet.

The drainage conditions of the Berks shale loam are generally good, except in the more nearly level areas, adjoining poorly drained areas of limestone soils where they are poor mainly on account of the poor internal drainage. Where the soil is deep the subsoil is of a rather impervious nature, and where the rock lies near the surface it retards the movement of water. When the water in the surface foot or more of soil in such areas is exhausted crops suffer from lack of moisture.

The type is easily worked and generally occurs where there are good transportation facilities, and it is very extensively cleared, but in some of the rougher, thinner areas farming is poor. The type is used for general farming, dairying, stock raising, trucking, and orcharding. It was at one time extensively used for peach growing, but this industry has now largely been transferred to the Dekalb and Upshur soils. Apples are grown in many places, and while this soil does not produce quite as high grade fruit as some of the other soils, the orchards seem to be in fairly good condition. The crops grown are wheat, corn, oats, hay, and potatoes. Wheat probably occupies a larger acreage than any other crop, and corn and oats are next in importance. Hay is not grown very extensively, and potatoes are grown only near the large towns. The yields vary widely, depending upon the depth of the soil, the season, the amount of fertilizer used, and the treatment given. On the better farms corn produces 30 to 40 bushels per acre, wheat 12 to 15 bushels, oats 20 to 25 bushels, and hay about 1 ton. On the poorer land where little or no fertilizer is used, and even on the good farms in dry seasons, the yields are very low, corn producing 10 to 20 bushels, wheat 8 to 10 bushels, oats 12 to 15 bushels, and hay about one-half ton per acre.

Almost all the best farms on this soil are dairy farms. Some cattle are raised, but beef production has never proved very profitable. Bluegrass is not indigenous on this soil and the pastures are not nearly so good as on the limestone land. Timothy gives much lower yields than on the bottom land or limestone land. In the vicinity of the larger towns trucking is quite profitable. Where trucking is practiced large quantities of manure and commercial fertilizer are used.

The usual crop rotation is followed, except that such crops as buckwheat and rye are substituted for grass following wheat more often than on the limestone land. Truck crops usually are grown in small patches, and do not enter into the rotation. The land is naturally not very strong, and some form of fertilizer, even in small quantities, is used by nearly all the farmers upon practically all crops. Fertilizer is used for wheat in larger quantities than on any other soil type in the area, especially where this crop is to be followed by grass, as much as 600 pounds per acre sometimes being applied. Liming is practiced to some extent on the best farms.

The improvements upon this shale land vary considerably. On some of the best dairy and truck farms near the towns and railroads they are as good as those found on the limestone land, while on the poorer farms and in sections remote from transportation facilities they are almost as poor as in the mountain sections. Land values generally range from $20 to $60 an acre. Some of the rougher land can be bought for about $10 an acre, while land near the larger towns and the more improved farms are held for as much as $100 an acre.

This soil requires building up before satisfactory crops can be produced. It is deficient in organic matter, which may be supplied by turning under crops, and is subject to erosion, which may be counteracted by growing cover crops. In the better drained and better aerated areas this soil is apparently alkaline or neutral and applications of lime are not necessary, but in the more poorly drained areas the use of lime is highly beneficial. While this type is not so well adapted to fruit as some of the other soils of the area, it can be utilized successfully for orcharding. In the well-drained areas of deep soil peaches should do well with proper care, and apples should succeed if the land were broken by blasting and some form of fertilizer used. Where general crops are grown some form of stock raising is highly advantageous, as applications of manure are necessary to maintain the productiveness of the type. Many of the steeper areas where the soil is thin or where the shale rock outcrops are best left in forest.

BERKS SILT LOAM.

The surface soil of the Berks silt loam, to a depth of 6 to 8 inches, is a brown to yellowish-brown, mellow silt loam, containing a few

scattered fragments of partially disintegrated shale. The surface soil is often gray when dry, but is brown under ordinary conditions. The soil is underlain by a light yellowish brown to yellow, friable and slightly compact silt loam which contains quite a few shale fragments. The shale content increases with depth until at 20 to 24 inches the subsoil passes into a bed of partially disintegrated shale. In places this shale is encountered nearer the surface.

In the level or more poorly drained areas, the subsoil is more deeply weathered than the typical, the shale being 30 inches below the surface in places. In these deep areas the lower part of the subsoil approaches a silty clay, which is somewhat stiff and mottled with gray.

This type, like the Berks shale loam, is derived from the Martinsburg shale, but it is much less extensive. It differs from the shale loam type mainly in having a much smoother topography and a deeper soil and containing less shale chips. It occurs throughout the shale belt, but the best part of the type is that along the junction of the shale with the limestone formation, where it is known as "border land." This border land is influenced to a slight extent by the limestone and is stronger than the shale areas. The basal members of the shale formation are more or less calcareous, and being softer than the remainder of the shale weather faster, giving rise to the silt loam included in the border land.

The drainage of most of this type is good, but there are many places in level areas or swalelike situations in which the underlying stratum of shale is more or less impervious to water. Aside from these poorly drained spots this soil is much more productive than the shale loam.

Practically all the type is cleared and under cultivation. The same general crops are grown and the same methods followed as on the shale loam type. The farms, however, are generally in much better condition. The average yields are in general about the same as on the better part of the shale loam. The yields of wheat and hay are higher than on the shale loam, wheat averaging 15 to 20 bushels and hay about 1 ton to 1½ tons per acre. The yields in the poorly drained areas are slightly lower than on the remainder of the type. These areas can be utilized to advantage for pasture as the native grasses are more abundant than in other places. There are several alfalfa fields on this soil, but the stands are not particularly good. More truck crops are grown on this type than on the shale loam. There are several large apple orchards on the type that seem to be in a thriving condition (see Pl. II, fig. 2).

This soil is valued at $60 to $100 an acre, according to improvements and location. The tree growth is slightly larger than on the shale loam; there is more hardwood and less scrub pine in evidence.

Fertilizers are used in about the same way as on the shale loam type. Liming is more commonly practiced, and more effort is made to build up the land by applying manure and turning under sod. For the improvement of this soil where it is in a run-down condition, liberal applications of lime, with the incorporation of large quantities of organic matter in the form of manure or clover, cowpeas, or other green-manure crop plowed under is needed. Where the drainage is not satisfactory, it is doubtful whether tile drainage would warrant the expense of installation, owing to the occurrence of the shale ledges near the surface, making it difficult to lay the tile. The areas of poor drainage are usually small and can be utilized for pasture. The soil seems well adapted to potatoes, especially where it is deep, and this crop could probably be grown more extensively with profit. The type is not so well suited to alfalfa or clover as the limestone soils, but fair success can be had where the land is thoroughly limed and inoculated and highly fertilized. Such legumes as cowpeas and soy beans seem to thrive, and have a beneficial effect on the soil. Orcharding might profitably be extended. There are other soils in the area better adapted to both apples and peaches, but the trees seem to be fairly healthy and fruit of good color and quality are produced. Heavy fertilization is necessary to successful fruit culture.

Berks silt loam, terrace phase.—The Berks silt loam, terrace phase, differs from the typical silt loam only in position. It occupies typical erosional terraces. The surface contains a little deposited material, derived mainly from shale areas. The phase lies about 20 to 40 feet above the general level of the first bottom. The topography is fairly level, with gentle swells and swales running parallel with the stream. Usually a poorly drained swale is found between the outer swell and the hill land. Such areas resemble closely the poorly drained areas of the typical Berks silt loam. The terrace phase is developed along Opequon Creek. The terraces are not very extensive, but are well defined.

The crops grown and yields obtained are approximately the same as on the main type. The phase is not used for fruit culture to any extent, as the trees do not thrive in the low positions. Hay is grown more extensively than on the typical soil, and proportionately larger areas are used for pasture.

The poorly drained parts of this phase can be drained without much expense. As their area is small, the disposal of the drainage is easily accomplished, and the absence of shale ledges makes it easy to lay the drains.

For its improvement this phase is in need of about the same treatment as the typical silt loam.

The following table shows the results of the mechanical analyses of samples of the soil and subsoil of the typical Berks silt loam:

Mechanical analyses of Berks silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
221705	Soil	8.2	6.6	1.7	2.8	2.6	60.6	17.7
221706	Subsoil	7.0	8.1	2.4	3.9	4.0	51.5	23.1

DEKALB STONY SANDY LOAM.

The Dekalb stony sandy loam consists of 6 to 10 inches of yellowish-brown or light grayish brown, medium to fine sandy loam, underlain by a yellow heavy sandy loam. Both soil and subsoil are loose and porous in structure. On the surface and mixed with the soil and subsoil are many fragments of gray, yellow, and reddish sandstone. Small fragments of sandstone may be numerous enough to make the soil gravelly. Shale fragments also occur in places. Bedrock lies near the surface in many places, and outcrops are common. The type as a whole varies from a rather stony fine sandy loam to rough stony land, which it generally borders, and as mapped it may include small areas of either of these soil classes, the entire area being more or less nonagricultural. Near the base of Sleepy Creek Mountain are bodies of soil which carry a large percentage of fine sandstone gravel. The agricultural value of this soil is not materially different from that of the typical stony sandy loam.

The Dekalb stony sandy loam occurs mainly on the eastern slope of Cacapon Mountain and the near-by ridges. A few areas near the base of the mountain are nearly level in places and not very stony, but the greater part of the type is steeply sloping. All of it is well drained.

Though scarcely an agricultural soil, some of the more nearly level areas are cleared and cultivated to a small extent after the larger stones have been removed. Crop yields are very light, especially in dry years, but buckwheat, rye, and corn are grown, and there are some small apple and peach orchards. As a whole this is probably the lowest priced land of any agricultural value in the area. Most of the type is covered with forest, which is largely chestnut and chestnut oak. Several large bearing chestnut groves are cared for in much the same manner as orchards, the nuts being gathered and sold.

Apples, peaches, and light truck crops might be grown profitably in the less stony areas if good transportation facilities were available.

Under present conditions most of the type seems better left in the native forest.

Dekalb stony sandy loam, deep phase.—The Dekalb stony sandy loam, deep phase, consists of 6 to 8 inches of grayish-brown to yellowish-brown medium sand to loamy sand, underlain by light-brown or pale-yellow loamy sand to loamy fine sand. The immediate surface is sometimes almost white, but both soil and subsoil have a darker yellow or orange color.

This soil is derived from the basal formations of the Oriskany sandstone, which consists of rather soft, yellow and gray sandstone. Large rounded bowlders and smaller fragments of sandstone occur on the surface and throughout the soil profile, but not often in large quantities. The phase is less stony than the typical soil. The topography is rolling to steep. The phase occupies the upper parts of some of the rougher ridges, the largest areas being on Warm Spring Ridge.

This phase occupies a considerable area. It is mainly in forest, which seems to be predominantly chestnut. Land values are generally very low, as little of the soil is improved and it is generally remote and inaccessible.

This soil on the eastern slope of Warm Spring Ridge is utilized to a small extent for agriculture. There are several large peach orchards. The trees are mainly young, but those that are of bearing age produce good fruit. The phase is also used for trucking to some extent. Tomatoes are the only truck crop grown on a commercial scale, but the appearance of home gardens indicates that the soil is well adapted to a variety of vegetables. Other crops, such as corn, oats, rye, buckwheat, and cowpeas are grown in a small way. The yields are low as a rule, especially in dry seasons, as the soil is droughty. Very little fertilizer is used.

For the improvement of this land the incorporation of organic matter is needed, both to improve its moisture-holding capacity and to increase its productiveness. The growing of legumes, such as cowpeas, vetch, and soy beans, to which this type is well suited, is beneficial to the soil. Complete fertilizers are needed on all crops, and in large quantities where truck crops are grown. The type is considered well suited to fruit, especially peaches, and with better shipping facilities it might be used profitably for trucking, but is too light for general farming, and the greater part of it, under present conditions, should probably best remain uncleared.

DEKALB STONY LOAM.

The surface soil of the Dekalb stony loam is a light-gray to yellowish-gray fine sandy loam to silty loam, 8 to 10 inches deep. It is underlain by yellowish loam or fine sandy loam, which may grade into a brownish-yellow or even reddish-yellow silty clay loam within

the 3-foot section. Scattered over the surface and mixed with the soil and subsoil are large quantities of angular, platy sandstone and quartzite fragments, and some shale fragments of yellow, gray, or reddish color and ranging in size from fine gravel to 1 foot or more in diameter. Bedded shale and sandstone outcrop on some of the steeper slopes, and along the mountains many large bowlders have rolled down upon this type and now lie on the surface or are imbedded in the soil material.

This soil is developed mainly on the crests of ridges, on the mountain sides, and on the steeper slopes. Typical areas occur on the east and west side of North Mountain, on Cacapon Mountain, the eastern slope of Sideling Hill Mountain, and the western slope of South Mountain. These areas are mainly steep and stony and not suited to agriculture. In the more nearly level areas and more favorable locations there are some apple and peach orchards. Small patches around the mountain cabins are cleared of stone and planted to corn, buckwheat, and garden crops. The vegetables are sold to near-by towns. Most of the type is in forest, consisting of oak, chestnut oak, pine, and chestnut. Drainage is everywhere thorough.

This type comprises areas similar in texture to the Dekalb shale loam and gravelly fine sandy loam, but containing so much stone and generally so steep that their tillage is impracticable. In other areas occurring as strips or small, narrow ridges parallel to the mountain ridges, in the western part of the survey, the material is derived from sandstone, and represents the best part of the type. In many places these areas are cleared and used for the production of general farm crops, tomatoes, apples, and peaches. The yields are about the same as on the Dekalb shale loam, and in some cases better.

This type is more deeply weathered than the shale loam of the series, and the rocks act to a certain extent as a mulch. The same general practices of farming are followed as on the shale loam. The price of this soil along the mountain sides is $10 to $15 an acre. Land along the ridges of the shale valleys is valued at $15 to $35 an acre, depending upon location and improvements.

This soil probably is best utilized for fruit production, and is better adapted to apples than to peaches. Owing to its ridgelike occurrence it furnishes excellent orchard sites. Patches can be used for growing tomatoes and other truck crops, where canneries can be reached. It is not a strong soil, and clearing the rocks from the stonier areas for general farming probably would not pay. Complete fertilizer is needed on all truck crops, and heavy applications of acid phosphate on cereals. Farming should not be attempted on the steeper and stonier parts of this type. They are probably best suited to forestry.

DEKALB SHALE LOAM.

The soil of the Dekalb shale loam typically is ashy gray at the surface, the color grading quickly into gray or yellowish gray. The soil material is prevailingly a loam to silt loam, although in some places the fine sand content is relatively high. The soil contains about 10 to 40 per cent of small shale fragments, ranging from gray to yellow in color. The subsoil is encountered at about 6 to 8 inches below the surface, and consists of a yellowish-brown to yellow loam to silty clay loam which is friable and only slightly compact. Yellow to yellowish-brown shale fragments comprise about 40 to 60 per cent of the subsoil. Below 24 inches the partially decomposed shale rock from which the soil is derived is encountered. This mass of rotten shale ranges from 3 to 20 feet in thickness, and passes into the unweathered shale. On the steeper slopes the shale rock outcrops, and in many places a mass of partially disintegrated shale occurs.

This type is derived from argillaceous and arenaceous shales and thin-bedded sandstone of several different formations. The soil material differs very little, but the character of the included shale fragments varies with the formation from which any particular area is derived.

The Marcellus shale, giving rise to one part of the type, is usually a black fissile shale, which weathers into small, thin, platy fragments. They are usually ashy gray at the surface and yellowish brown to reddish brown underneath. In places the soil consists almost entirely of these shale fragments, and in spots the fragments are large and angular. The soil derived from the Marcellus formation occurs in a strip along the western base of North Mountain. The western boundary of this strip extends along Leading Ridge northward to the Potomac River, passing about one-half mile west of Baxter and Holton and about 3 miles west of Cherry Run. This strip passes through the area, and is about $2\frac{1}{2}$ miles wide at the Virginia line, broadening to about 5 miles along the Potomac River. A strip about one-half mile wide extends along the eastern base of Warm Spring Ridge northward from the Virginia line to the vicinity of Brosius. Another strip extends along the western base of Little Mountain and Tonoloway Ridge from the Hampshire County line to Great Cacapon.

Another part of the type is derived from the Portage and Genesee formations, and the shale fragments are somewhat larger and more arenaceous than in the soil from the Marcellus shale. They are blocky in shape, brown or yellowish brown in color, and less numerous in the soil. This rock is more deeply weathered as a rule than the Marcellus. Many areas of this part of the type more nearly resemble the Dekalb gravelly loam. Small fragments of sandstone are com-

monly scattered over the surface, as there is considerable embedded sandstone near the top of the formations. The soil derived from the Portage and Genesee formations occurs in a narrow belt about a mile wide along the west side of Leading Ridge. Another strip, which is comparatively broad, extends from the mouth of Sleepy Creek to the Virginia State line, its western boundary being coincident with the eastern boundary of the Marcellus shale belt east of Warm Spring Ridge. A belt about a mile wide extends from the Potomac River between Great Cacapon and Woodmont southward to the Hampshire County line, and another strip occurs west of Purslane Mountain along the Potomac River, filling the large bends at Magnolia and Doe Gully. The areas in these bends are broken by narrow ridges of the Dekalb stony loam.

A third part of the type is derived from the Harpers shale. This formation is highly metamorphosed, and the shales are thin and platy. They are gray at the surface, yellow in the subsoil, and greenish gray in the substrata near the parent rock. Bowlders and fragments of quartz are found on the surface. This formation occurs in the eastern part of the area extending along the western base of South Mountain in a belt about 1½ miles wide from Harpers Ferry to the Virginia State line.

The type is more extensively developed in the western half of the area. It occupies the shale valleys between the mountain ridges. The general surface of low hills and ridges forming the valley is about 1,000 feet above sea level. The streams have cut down to about 500 feet, giving a range in elevation of about 500 feet. The topography is rolling to steep along the small stream valley walls. The rolling relief gives ample surface drainage, while the loose nature of the shale often makes the internal drainage excessive, and crops are likely to suffer for lack of moisture even in comparatively dry seasons. In small, depressed areas, as about stream heads, in those parts of the type derived from the Marcellus and Harpers shales the drainage is poor, and drab, gray, and even white mottlings appear in the subsoil.

The Dekalb shale loam is the second most extensive soil in the area. Probably two-thirds of the type is forested, the forest growth differing considerably with the occurrence of the shale formations from which the type is derived. Over a part of the type the growth is predominantly scrub pine with a scattering of oak and other hardwood trees usually not very sturdy in growth. Another part supports a growth of scrub pine, with some mountain pine and a scattering of scrub oak and other hardwood trees. In other places there is a heavier timber growth, with less scrub pine and more oak. The hardwood trees are more numerous, but the forest growth is not nearly so

heavy as on the limestone soils. The underbrush is scant over nearly all the type.

The part of the type derived from the arenaceous shale formation is used more extensively than the others for agriculture. General farming, stock raising, and orcharding are practiced throughout the type in general. Corn, wheat, buckwheat, and oats are the principal crops grown. Hay is grown on a very small acreage. This soil is utilized to some extent in Sleepy Creek Valley for growing tomatoes for canning. Peach and apple orcharding is developed to some extent in Back Creek Valley and Sleepy Creek Valley. Small areas of the soil are in pasture. Grass does not make a good stand, but cattle graze in the woods to some extent and subsist upon the native grasses and undergrowth.

Crops frequently fail on this soil in dry seasons. Where little effort is made to keep up the organic-matter content of the soil, and where no lime or fertilizer is used crop yields are low. On the better farms crops do fairly well. Corn yields 20 to 30 bushels on the best farms, but yields of 10 bushels per acre are common on the poorer farms. Wheat yields 12 to 15 bushels when fertilized, and 8 to 10 bushels under ordinary conditions. Buckwheat averages 15 to 20 bushels per acre, and hay yields one-half to 1 ton. Clover is uncertain, and cowpeas are depended upon to a small extent to supplement this crop.

Peaches seem to do well, and there are several large orchards on the type. Apples are more extensively developed than any other orchard crop. There are many thriving apple orchards that produce good yields of fruit of good quality and color.

The gravelly nature of this soil makes it easy to keep in good tilth. It dries out very quickly after rains, and should be plowed before it becomes too dry. For this reason many fields may be seen that are only partially planted, the remainder of the field being left because too dry to plow. The rotations common to the shale-valley section are followed; these differ from those of the limestone valley in containing less corn and grass and more buckwheat. Liming is practiced to a small extent. In places commercial fertilizers are used in large quantities, mainly acid phosphate and bone meal. Some farmers apply as much as 300 to 500 pounds of fertilizer per acre for wheat, corn, tomatoes, and buckwheat. On some farms little or no fertilizer is used. On such farms the equipment is inferior, and the buildings show a lack of improvement.

Very little of this type can be bought for less than $10 an acre. The better developed areas sell for $25 to $35 an acre, while some land near towns or in bearing orchard is held at a much higher price. This soil is known locally as "shale," "black shale," "soapstone," or "slate" land. As a rule it does not have a very high value as farm

land. The areas in the Back Creek Valley and around Berkeley Springs probably are better developed and command a higher price than those in other parts of the area.

Among the chief needs for improving this soil is the addition of organic matter. The organic-matter content is very low, even on some of the best improved farms. This can be supplied by turning under sod or cover crops or incorporating manure. Some sod land is turned, but this is most effective if included in a definite rotation. Cover crops or catch crops, such as rye, clover, cowpeas, or buckwheat, could be turned under to advantage. The keeping of live stock and the proper use of the manure is highly beneficial. This soil is well suited to such legumes as cowpeas, soy beans, and vetch, which could be substituted where clover does not make a good stand. Liming should be practiced more generally, heavy applications being made where grass or other crops are turned under. The apple industry apparently could profitably be extended on this soil, as its topography and character is well suited to apple orcharding. Where truck crops are to be grown, in addition to the general methods of soil improvement the application of complete fertilizers is needed for best results.

DEKALB SILT LOAM.

The Dekalb silt loam consists of a yellowish or grayish-brown heavy silt loam, often with a slight olive tint, grading below into a yellow or yellowish-brown, friable silty clay, sometimes mottled with drab and yellow. Generally this soil is fairly deep, but in some places the disintegrating shale is encountered at about 24 inches. A few small shale fragments are present on the surface, and in some places there are enough angular pieces of sandstone to make local areas decidedly stony. Included in the Dekalb silt loam are patches of Dekalb loam.

The Dekalb silt loam is chiefly developed in detached areas in the shale valleys to the west of North Mountain, where it occupies the more nearly level areas within the Dekalb shale loam, which have not been made thin and gravelly by surface erosion. The two types merge gradually, and the line of separation is often somewhat arbitrary. The topography is gently rolling, and the surface drainage is adequate, but owing to its rather dense subsoil the silt loam is likely to be wet and soggy in the more nearly level or depressed areas. Some areas are mapped on the more nearly level tops of ridges, and in these areas the drainage is good.

Most of this type is cleared, and the usual system of general farming is followed. The soil, being deep and rather heavy, is retentive of moisture. Owing mainly to the low organic-matter content, resulting mainly from an exhaustive system of farming, the soil is

rather difficult to work and has a tendency to clod and crust. It dries out very quickly after rains, and often becomes too hard to plow before cultivations are finished. This type, however, is less affected in this way than the Dekalb shale loam.

A considerable part of the type is under cultivation, especially near Berkeley Springs. Corn yields 20 to 35 bushels per acre, wheat 15 bushels or less, and hay 1 ton to 1½ tons. There are some good orchards on the type. Lime and fertilizer are sparingly used.

The Dekalb silt loam as a rule is fairly well improved, and farms on it sell for $25 or more an acre.

Crop yields could be greatly improved by plowing under green-manure crops or stable manure, by more thorough cultivation, liming, and the liberal use of phosphatic fertilizers. A part of the type is probably better suited to grass and pasture than to cultivated crops.

UPSHUR STONY SILT LOAM.

The soil of the Upshur stony silt loam is reddish-brown, mellow loam to silt loam containing some fragments of red shale and red sandstone. Scattered over the surface and throughout the soil are pieces of red and gray sandstone varying in size from a few inches to a foot in diameter. The subsoil is usually encountered at 10 to 12 inches below the surface and consists of an Indian-red loam to clay loam filled with fragments of red sandstone and shale.

In the extreme southeastern corner of the area on the crest of the Blue Ridge, extending north from the Virginia line for a short distance, the soil is brown and is underlain by a red clay loam. This soil is derived from schist rock, instead of the sandstone and shale giving rise to the Upshur soils. It would be mapped as the Porters stony clay loam if of sufficient extent to warrant separation. The type also contains small areas of the Dekalb stony loam which can not be shown satisfactorily on the map. In places in the type the fine sand content is very high.

The Upshur stony silt loam occurs on the sides and at the bases of the mountains, and the topography is fairly steep. The drainage is excessive. The soil is derived from red shale and red sandstone. Fragments and bowlders of gray sandstone are found on the surface or imbedded in the soil. These are derived from the Purslane sandstone which outcrops higher up on the mountain. The type occupies narrow strips on the lower slopes and along the base of Sleepy Creek-Third Hill and Sideling Hill-Purslane Mountains. The elevation ranges from 1,000 to 1,200 feet above sea level.

Most of this soil is forested with chestnut and chestnut oak and a scattering of other hardwoods. The undergrowth is unusually thick. Clearings and orchards on the Upshur gravelly silt loam usually

terminate when they reach the stony land of this type. Only a few clearings have been made on this soil and the agriculture is confined to patches of corn and vegetables, with a few peach orchards. The largest openings are in pasture. The more nearly level areas when cleared of stone have about the same crop value as the gravelly silt loam type.

The Upshur stony silt loam is not very well suited to the production of general farm crops on account of its steep topography. However, some corn and wheat are grown. The smoother, less stony patches with transportation facilities can be used for trucking. The type can profitably be used for orcharding where not too steep. It is probably best suited to peaches, but small fruits do well. Some areas are best used for pasture. Although bluegrass does not make a strong growth it furnishes better grazing than on the surrounding Dekalb soils. The steeper areas are probably best suited to forestry.

UPSHUR GRAVELLY SILT LOAM.

The surface soil of the Upshur gravelly silt loam consists of Indian-red or pinkish-red silty loam, 6 to 10 inches deep. The subsoil differs but little from the surface material, except that it has more of an Indian-red color. Both soil and subsoil carry 15 to 60 per cent of angular red shale and sandstone chips. The shale content and size of the fragments increase with depth, and at about 20 inches a mass of broken rock may be encountered. On the steeper slopes, ledges of shale and thin sandstone outcrop in places. This soil has an extensive development in the western part of the area. The largest bodies occur as a belt about a mile wide extending along the base and around the end of Sleepy Creek-Third Hill Mountain. Similar strips occur along the base of Sideling Hill-Purslane Mountain.

This soil is derived from the Catskill formation, which consists of beds of red shale, arenaceous shale, and thin-bedded, fine-grained sandstone. It occurs over the more rolling parts of the formation and where it is not influenced by overlying strata. This type is closely associated with the Dekalb shale loam, and it is sometimes difficult to make an accurate separation where the two types adjoin. Small areas of Upshur gravelly fine sandy loam are scattered over the type, but these are too small and the boundaries too indefinite to warrant separation.

The Upshur gravelly silt loam occupies low, rolling hills and slopes in the shale valleys. The topography is often steep. The type has good drainage and next to the Upshur silt loam is regarded as the most desirable land in the shale valleys. The more nearly level areas and gentle slopes are extensively cleared and cultivated. The type of farming commonly practiced in the shale valleys is followed. Oats probably yield better than any other crop, produc-

ing 20 to 30 bushels per acre. Buckwheat has an important place in the cropping system and is grown mainly in orchards. It averages between 15 and 20 bushels per acre. Corn yields about 25 to 30 bushels, wheat 10 bushels, and rye 12 bushels per acre. Hay yields are light. There are several large orchards on this type. This is one of the most extensively used soils in the area for peaches. Several large commercial orchards are located on this type and the Upshur silt loam. Apples seem to do well. The Grimes and the York Imperial are the leading varieties. The soil is easily cultivated, has good depth in the more nearly level areas, and is not subject to erosion to any great extent, so that orchards may be kept well tilled.

Farms on this type seem to be rather better improved than upon the Dekalb soils. Land values range from about $15 to $35 an acre, depending upon the topography, location, improvement, and orchard possibilities. The native forest growth is predominantly chestnut and chestnut oak. The type is sometimes referred to locally as "red chestnut land."

This soil is well suited to orcharding. It is particularly well adapted to peach production, and this industry apparently could profitably be extended. The type is better suited to oats than the other small grains. It is not so much in need of fertilizer as the Dekalb soils, but for best results some acid phosphate should be used with cereals, and unless legumes are grown to furnish nitrogen, nitrate of soda as a top-dressing should be used with oats. This is not a particularly strong soil, and the addition of organic matter and deep plowing are beneficial, both in increasing the productiveness and improving the moisture-holding capacity of the soil.

UPSHUR SILT LOAM.

The soil of the Upshur silt loam to a depth of 8 or 10 inches is an Indian-red to reddish-brown, mellow silt loam containing a few well-decomposed fragments of red shale and fine-grained sandstone. This is underlain by a subsoil of red to Indian-red, somewhat compact, friable silt loam to silty clay loam, which contains fragments similar to those in the soil, the quantity increasing with depth. Below 24 to 30 inches these fragments are often sufficiently numerous to interfere with boring.

This soil occurs in round or oval-shaped areas throughout the Upshur gravelly silt loam, and is derived from the same formation. It has a small total area. The largest bodies are found in Morgan County between Paw Paw and the base of Sideling Hill Mountain, between Highland Church and Sleepy Creek Mountain, and between the Potomac River and Devils Nose, of the northern end of Third Hill Mountain.

The topography is more nearly level than that of the gravelly silt loam type, being flat to gently undulating or gradually sloping. Drainage is good. The red color of the material is due more to the color of the rock from which it is derived than to oxidation. The average elevation of the type is between 750 and 1,000 feet above sea level.

The Upshur silt loam is practically all cleared and under cultivation. The original forest growth consists of more hardwood than that in the gravelly areas, with considerable chestnut. This soil is considered the best in the "hill country," and is utilized for general farming, stock raising, trucking, and orcharding. Corn, oats, buckwheat, wheat, timothy, and clover are grown and rank in importance in about the order named. Some beef cattle and sheep are raised, although bluegrass is not very strong on this type. Relatively small areas are in pasture, as the land is more suitable for tilled crops. The improvements are good. Well-developed orchards are distributed over all parts of the type. It is particularly suited to peach production, and some of the largest and best orchards in the State are located on this soil and the adjoining Upshur gravelly silt loam.

The yields of general farm crops are good. The methods used are about the same as on the limestone-valley farms. The usual rotations are followed. Corn yields 30 to 40 bushels per acre, wheat 12 to 20 bushels, oats 25 to 30 bushels, buckwheat 20 to 25 bushels, and hay about 1 ton to 1½ tons.

Fertilizer and lime are used possibly more than on any of the other hill soils. In general, the farmers on this type are more prosperous and follow more up-to-date methods. The farm equipment as a rule is better than in the surrounding areas, and approaches that on the farms of the limestone valley.

The lime content of this soil is low, and applications of this material should prove beneficial. The incorporation of an adequate supply of organic matter and proper plowing puts the soil in good physical condition. The stone content is very low, and disk plows and cultivators can be used to advantage. The use of phosphatic fertilizers is beneficial for cereals and complete fertilizer for truck crops. Clovers and legumes, such as cowpeas and vetch, are well suited to this soil, and should be included in the rotations. Oats and vetch make a good combination, especially where dairying or stock raising is practiced.

ELK GRAVELLY LOAM.

The Elk gravelly loam varies considerably in texture, quantity of gravel present, and depth. In general the surface soil has a grayish-brown to yellowish-brown color, is fairly loose and open, and consists

of a loam, fine sandy loam, or sandy loam. About 6 to 10 inches below the surface a transitional layer between the soil and subsoil is encountered. This is yellowish brown in color, and slightly heavier in texture than the soil, consisting of a heavy fine sandy loam or sandy loam. This layer is 4 to 6 inches in depth. The subsoil proper may be encountered anywhere below 12 inches and is a heavy reddish-brown to red clay. The soil and the intermediate layer contain about 30 to 40 per cent of small, rounded gravel of quartz and sandstone origin. The subsoil contains relatively small quantities of sand and gravel. Scattered over the surface, usually near the streams, some rounded sandstone rocks are encountered, varying from a few inches to almost a foot in diameter and known locally as " heads."

The surface soil material of this type is alluvial, while the subsoil is in part residual. The subsoil is derived from limestone, and the overlying material was deposited by the larger streams when their channels were at a much higher level than at the present time. These deposits are not extensive, rarely covering more than 1 square mile. They are seldom more than 3 feet in depth, and nowhere do they seem to be more than 10 feet deep. This soil is spoken of locally as "sand land" to differentiate it from the limestone or shale land.

The Elk gravelly loam usually occupies the necks formed by the large river bends in the limestone valley. It occurs along the Potomac River below North Mountain, in such places as Whitings and Terrapin Necks, and along the Shenandoah River below Cattail Run. The areas along the Potomac River, as a rule, are deeper and the soil more of a loam or fine sandy loam than along the Shenandoah, where the soil is shallow and sandy, with relatively little gravel. The subsoil of the Shenandoah areas is deep red, like that of the Decatur soils, while along the Potomac it is reddish brown and more like the Hagerstown. The limestone from which this soil is derived seems to be deeply weathered, as no limestone rock is encountered in the 3-foot profile.

The topography is fairly level to gently rolling. The general level of the type is about 100 feet above the streams, but it varies between about 50 and 150 feet. The topography and the character of the substratum are favorable for good surface drainage and underdrainage.

Most of this soil is cleared and under cultivation. The forested areas support a growth of hardwood, with scrubby oak predominating. General farming and stock raising are practiced. Corn is the leading crop; wheat ranks second and hay (timothy and clover) third in importance. Small areas are in pasture. Some orchards are found, but as a rule they are small.

This soil is not naturally so strong as the limestone soils, but where manure, lime, and phosphatic fertilizer are used, the yields are fairly

good. Corn produces 40 to 50 bushels per acre. Wheat gives somewhat lower yields than on the limestone land, ranging from 8 to 15 bushels. Oats yield 20 to 35 bushels and hay about 1 ton per acre.

The soil is light and more easily handled than the limestone soil and is considered more desirable than the shale soil. The gravel acts as a mulch and conserves the moisture held by the heavier clay subsoil. This is sufficient for growing crops in nearly all seasons and saves considerable tillage. The stones often interfere with the harvesting of wheat, oats, and hay. The usual rotations are followed. On the better farms, manure, lime, and fertilizer are used. Acid phosphate is used at the rate of 250 to 300 pounds per acre for wheat and corn.

In the southeastern part of Jefferson County some of this land can be bought for $25 or $30 an acre. Most of the type is valued at $75 to $100 an acre.

This soil is usually deficient in organic matter, which may be supplied by turning under cover crops or sod. The type is well suited to the growing of such legumes as cowpeas, soy beans, and vetch, and these are beneficial in the rotations. The soil is probably better adapted to corn than to any other general farm crop. It is well suited to vegetables, and truck crops could probably be grown profitably, provided transportation facilities were available. Complete fertilizers are needed for truck crops. Peaches and small fruit do well.

HOLSTON SILT LOAM.

The soil of the Holston silt loam typically is a gray to grayish-brown, mellow silt loam about 8 to 10 inches deep. This is underlain by a yellow to yellowish-brown heavy silt loam which is friable and only slightly compact. The type is subject to some variation along the Cacapon River, where the sand content is higher, the soil approaching a fine sandy loam in texture, and in places along the terraces of the Potomac River above Lineburg, where rounded gravel and " heads" are scattered over the surface and sometimes occur in thin beds 5 to 10 feet below the surface. Most of the type contains a few scattered shale and sandstone fragments.

The Holston silt loam is a terrace or second-bottom type lying above overflow along the larger streams west of North Mountain. This soil consists of wash from the Dekalb and associated soils. It is situated usually between the first bottom and the upland, lying 20 to 100 feet above the general level of the first bottom. The topography is level to gently undulating. The drainage is usually good, but in a few places where the underlying rock formation is near the surface the downward movement of water is checked and the drainage conditions are not very good. The largest and most typical

areas of this type are found at Great Cacapon, Paw Paw, and Orleans Crossroads.

This soil was at one time covered with a heavy forest consisting largely of oak, hickory, walnut, beech, and chestnut. On account of the evenness of its topography, this land, occurring in an otherwise hilly country, is utilized to a large extent for town sites, buildings, etc., and its high value is due to its use for these purposes rather than for agriculture. Practically all the type not so used is cleared and under cultivation. It is used for general farming, orcharding, and trucking. The crops grown are corn, wheat, oats, buckwheat, and hay (timothy and clover). Apples are grown to some extent, and the orchards on the higher terraces produce fruit of good quality and color. Tomatoes are about the only truck crop grown. Potatoes and other vegetables are grown in gardens and give good yields. The usual crop rotations are followed. Yields vary widely on this soil, depending on the care given the soil. On the best farms corn yields about 40 to 50 bushels, wheat 15 to 25 bushels, oats 20 to 30 bushels, hay (timothy) 1 ton to 2½ tons, and potatoes about 150 to 200 bushels per acre. On the poorer farms where little fertilizer is used and very little sod land turned the yields are somewhat lower, corn producing 20 to 30 bushels, wheat 12 to 15 bushels, oats an average of about 20 bushels, and hay somewhat less than 1 ton per acre. Potatoes on these farms are grown under garden conditions and yield as well as on the better farms Probably more lime and fertilizer per acre is used upon this type than on any other soil in the area.

Very little of this type can be bought for less than $100 an acre, and much of it is valued at $200 to $300 an acre.

On a soil valued at this price intensive methods of farming must be practiced in order to make agriculture profitable. The growing of more leguminous crops, such as clover, cowpeas, soy beans, and vetch, is needed to reestablish and maintain the productiveness of the soil. These crops should be used in the rotations. The growing of truck crops, especially potatoes, apparently could profitably be extended. The soil is well suited to potatoes, and high yields can be obtained by the use of proper methods including the application of high-grade fertilizer. Alfalfa can be grown successfully with heavy liming and proper preparation of the seed bed. Where the soil has been allowed to run down it is in need of organic matter. This can best be supplied by turning under sod land or cover crops, or by using manure, and liming. Fertilizers are beneficial to all crops. Acid phosphate or bone meal is needed with cereals and grasses, and complete fertilizer with other crops. A good quality of tobacco is grown on this type in other parts of West Virginia.

POPE FINE SANDY LOAM.

The Pope fine sandy loam consists of 6 to 8 inches of a dark-brown or reddish-brown, mellow fine sandy loam to light loam, underlain by a light brownish yellow, heavier fine sandy loam, which may grade into a fairly heavy loam at greater depths. The type occupies level first bottoms along the larger streams, as along the upper part of Back Creek and Cacapon River, and also the smaller streams in the southwestern part of the area. It is derived from alluvial material carried down from the Dekalb soils and deposited in time of high water. A very small proportion of limestone material may be included, as a small number of the streams drain soils of limestone origin. There is considerable variation in texture, the larger bottoms generally grading from a light, fine sandy loam near the stream into a loam or even a silt loam where the slope to the upland begins. The heavier material, where sufficiently extensive, is mapped as the Pope silt loam. The small bottoms are sometimes gravelly or even stony along the streams.

The stream bottoms occupied by this type are occasionally inundated, perhaps once in 5 years, but the water never stands on the land for more than a few hours, and floods do not seem to interfere seriously with the growing of any crop. Some small areas are lower and are subject to more frequent overflow and to rather severe washing, so that they are useful for pasture only. The drainage of the type is good, except in the strip of heavier material along the upland.

This is considered one of the best and most productive soils of the hill section, and all the areas of any size lying high enough to escape frequent overflows are cleared and cultivated. The usual type of farming and the usual crop rotations are followed. Corn yields 40 to 50 bushels per acre, wheat 15 to 20 bushels, and hay 1 ton to 2 tons. Corn is the principal crop, and timothy hay second. Some oats and a little wheat are grown.

These bottoms are usually fertilized and receive good treatment at the expense of the upland soils, which are generally in need of both. Farms along the bottoms are well improved. The land is valued at $25 to $40 an acre, depending on location, character of the buildings, and the area of bottom land included in the farm. This soil at present has poor transportation facilities, but is otherwise well suited to trucking. Legumes, such as cowpeas, soy beans, and clover, should be grown more extensively. Where the soil is subject to only occasional overflow complete fertilizer should be used with most of the crops.

In the following table are shown the results of the mechanical analyses of samples of the soil and subsoil of the Pope fine sandy loam:

Mechanical analyses of Pope fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
221753	Soil	0.7	2.6	3.2	30.2	26.2	27.9	8.9
221754	Subsoil	.4	.6	.9	22.0	25.5	34.6	15.6

POPE SILT LOAM.

The Pope silt loam consists of a brownish, yellowish, or grayish silt loam, 6 to 10 inches deep, underlain by a pale yellowish brown or light-brown heavy silt loam. The material is heavier in texture and lighter in color below about 20 inches. Poorly drained areas near the uplands may have a whitish surface with some drab mottlings in the subsoil. Sandstone fragments and small shale chips are often quite numerous along the smaller streams where the bottoms are narrow. This type represents the alluvial material derived almost exclusively from sandstone and shale, with some slight limestone influence. It occupies first bottoms and along the smaller streams is subject to overflow, but on the broader bottoms of the larger creeks it is not flooded to a serious extent, except at times of unusually high water. In the larger bottoms this type generally occupies the position farthest from the stream.

The type is often poorly drained, as it may lie a little lower than the soil nearer the stream, so that the surface water can not readily drain off. It is also in a position to receive the seepage from the uplands, and having a close-structured subsoil, it often stays wet until late in the spring. The Pope silt loam is composed mainly of wash from the Dekalb soils, and is mapped along the streams west of North Mountain. Its largest areas are along Back Creek and the upper part of Sleepy Creek.

This type is almost all cleared and cultivated, except where the bottoms are small and isolated or where they are very low and subject to frequent overflow. A few of the higher areas are well drained and seldom overflowed, and are almost as valuable for the production of corn as the Huntington silt loam. In general, however, this soil is somewhat less productive than the Huntington and Moshannon soils. It is more refractory than the Pope fine sandy loam and, not being so well drained, is a colder and later soil, but it is productive and in favorable seasons yields are quite satisfactory. Wheat may be subject to winter injury, especially if the land is wet, and clover does not catch very well and is likely to be heaved out

by alternate freezing and thawing during the winter. The type, however, is well suited to grass, and probably one-half the type is in pasture. Adequate drainage is in places obtained by digging an open ditch along the edge of the upland to carry off the surface water and also to catch the seepage and empty it into the streams at some lower point. In most places the smaller bottoms do not need drainage, but they are more subject to overflow. In order to be shown on the soil map these small bottoms and meadows are often made to include narrow strips of colluvial material. The type supports a scattered growth of sycamore and willow.

There is very little difference between the value of the Pope silt loam and the Pope fine sandy loam. Where drainage of the wetter areas is impossible, they might better be kept in hay and pasture grasses, such as timothy and redtop. Open ditches and tile drains could be used to advantage on the lower or more poorly drained parts of this type. Lime and stable manure are generally needed to improve the physical condition of the soil and increase its productiveness. With proper drainage the type seems best suited to corn and timothy.

In the following table are shown the results of the mechanical analyses of samples of the soil and subsoil of the Pope silt loam:

Mechanical analyses of Pope silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
221723	Soil	0.0	0.5	1.6	8.0	15.0	57.4	17.8
221724	Subsoil	.0	.3	1.6	9.5	14.8	52.4	21.2

MOSHANNON SILT LOAM.

The soil of the Moshannon silt loam is about 10 to 12 inches deep, and consists of a reddish-brown, mellow silt loam. The soil grades imperceptibly into a subsoil of reddish-brown to Indian-red, slightly compact, friable silt loam, which becomes slightly more compact and heavier with depth, the material below about 20 inches approaching a silty clay loam.

This soil occurs as first-bottom overflow land along streams which receive most of their drainage from the Upshur soils. The topography is nearly nevel. The drainage over most of the bottom is well established. The general elevation of this soil is 10 to 15 feet above the stream. Typical areas are encountered along Sleepy Creek below the junction of Middle Fork, and along Middle and South Forks of Sleepy Creek, the largest single area being that in the large bottoms just above Smiths Crossroads. Along Mountain Run and on Sleepy Creek below New Hope, the bottoms contain a high percentage of

fine sand, and more nearly represent Moshannon fine sandy loam. This is true also of a narrow strip along the stream edge of most of the type. In such places small quantities of waterworn gravel of sandstone origin are present.

Most of this type is cleared and is under cultivation or in pasture. A small acreage is used for hay production. Most of the cultivated area is in corn. Wheat and oats are grown to a small extent; they have a decided tendency to lodge. Pumpkins and tomatoes are grown successfully, the former in the cornfields and the latter in small patches, for canning. Sweet potatoes are grown in small patches. Corn seems to do better than any other crop, yields ranging from 50 to 60 bushels per acre. Oats produce 20 to 30 bushels per acre, wheat 12 to 15 bushels, and timothy hay 1½ to 2½ tons per acre. Crops are seldom damaged by the floods. Late summer floods do the most damage, but they are not of frequent occurrence. Most of the type lies above normal overflow. The forest growth consists of sycamore, elm, beech, birch, and willow.

The equipment on the farms is usually good, the implements used are of the same type as those used on the limestone-valley farms. Very few buildings are located on this soil owing to the danger of floods. No fertilizer or lime is used except on truck crops. Complete fertilizer is used where tomatoes are grown for canning.

Most of this land is valued at $40 to $50 an acre, but some of the undeveloped areas can be bought for $20 to $25 an acre. Some of the best improved land is held for as much as $100 an acre.

The Moshannon silt loam is easily tilled; very little difficulty is experienced in the preparation of the seed bed or subsequent cultivations. This characteristic, with its natural productiveness, makes it one of the most desirable soils for general farming in the shale valleys. The crops that seem to do best are corn and hay. This land has too high a value for cultivated crops to be used as grazing land. As the mowings begin to run out it may be advisable to use the land for grazing cattle for a season before it is turned under and put in corn. Such crops as cowpeas and vetch should be grown with the hay crops, as this soil is well suited to this class of legumes. Alfalfa would probably succeed in the higher areas of this soil. This soil does not seem to be particularly in need of fertilizers or lime, as the annual inundations seem to keep it in good condition. Where truck crops are grown complete fertilizer is needed. With the establishment of the canneries within easy reach of this type trucking should prove profitable.

HUNTINGTON SILT LOAM.

The Huntington silt loam as developed along the larger streams such as the Potomac and Shenandoah Rivers is uniform in character, and consists of a dark-brown or chocolate-brown, mellow silt loam,

grading at about 10 to 12 inches into slightly lighter brown material of about the same texture and structure. It contains a little sand along the stream banks, and a few waterworn pebbles are scattered through both soil and subsoil.

Along the smaller streams of the Shenandoah Valley the type varies somewhat. The soil is prevailingly a dark-brown to light-brown heavy silt loam, underlain at 8 to 10 inches by a yellowish-brown or, in places, a mottled brown, heavy silt loam to clay loam. Small areas of almost black surface soil with a heavy drab or mottled drab and yellow clay loam subsoil are included with the type. Along the smaller streams there are some spots of fine sandy loam, and stony and even gravelly areas occur in some places. Often the type is locally influenced by shale material where the adjacent upland is shale. There are also small spots in which the surface soil consists of 6 to 12 inches of a gray to dark-brown loam or clay loam and the subsoil is a drab silty clay loam mottled with yellow and containing specks or nodules of white marl. Frequently below 24 inches an ashy-gray, loose marly loam is encountered. In places the surface is gray and the subsoil consists of white marl. These marly areas are usually found immediately below springs that issue from a limestone formation.

The Huntington silt loam occurs as first-bottom overflow land along the streams that receive all or a considerable part of their drainage from limestone soils. The bottom lands along the larger streams lie about 20 to 40 feet above stream level, and along the smaller streams they range from a few feet to about 20 feet above. Most of the type is subject to occasional overflow, but the high bottoms along the larger streams are flooded only in late winter or in early spring before crops are planted.

The topography is fairly level with occasional low swales next to the upland, but more often higher, gently sloping areas of wash or talus material are found adjacent to the upland. The drainage is well established over most of the type, although in places along the smaller streams the currents are sluggish and semimarshy conditions prevail. The areas of dark surface material and the marl areas are usually poorly drained. In the better drained areas crops do not suffer for lack of moisture in dry seasons. The annual inundations keep the soil productive and in good conditon.

The Huntington silt loam is an important farm soil. Practically all of it is cleared and under cultivation. Some timber is left along the edges of streams and hills, consisting of sycamore, elm, and willow. The original forest growth apparently was very heavy. There are many large willow groves near old springs. Nearly all the bottom land along the rivers is planted to cultivated crops each season, while along the smaller streams about one-half the type is in

permanent pasture, the remainder being cultivated. The poorly drained areas are nearly all in pasture.

Corn is by far the most important crop on this soil, occupying an acreage greater than that of all the other crops combined. Hay is the next crop in importance. Very little wheat and oats are grown. Alfalfa is grown successfully in the higher, better aerated parts of the type, but occupies a small acreage. Obnoxious weeds cause considerable trouble on hay and pasture land.

This is one of the most productive soils in the area. Heavy yields are obtained without the use of manure or commercial fertilizer. Corn yields 40 to 60 bushels per acre, with occasional yields of as much as 80 bushels per acre. In a few cases, where fertilized, corn has produced 100 bushels per acre. Wheat yields 18 to 20 bushels, oats 25 to 35 bushels, and timothy hay 2 tons per acre.

In most cases this soil occupies only a part of the farm and it is generally utilized in corn, hay, or pasture. Some of it remains in pasture for long periods and some areas are planted to corn year after year, no definite rotation being followed. Fertilizer, lime, and manure are not used except on the higher parts of the type that lie above normal overflow. Small areas are used for growing water cress, the stream being dammed and the backwater used for that purpose. The Huntington silt loam is valued at $100 an acre.

The productiveness of this soil is maintained by the overflows which leave rich deposits of mineral and organic matter. The type is better suited to corn than to any other crop and this crop might profitably be extended, although some form of rotation should be practiced. The soil is well suited to truck crops such as tomatoes, potatoes, and nearly all the vegetables commonly grown in this section and can be utilized successfully for these crops where market and transportation facilities are available. Near the streams or in areas where the surface is inclined to wash or is so low that drainage can not be effected the type is best kept in pasture. The alfalfa acreage might be extended advantageously in the higher, better aerated places. The land is sufficiently valuable to warrant tile drainage of the poorly drained areas. The marl could be used advantageously on the upland soils in the place of lime.

ROUGH STONY LAND.

A large part of the slopes of South Mountain, North Mountain, Cacapon Mountain, Sleepy Creek-Third Hill and Sideling Hill-Purslane Mountains, and also parts of the smaller mountains, together with the crests of some of the more rugged ridges, are either too steep or too completely covered with rock outcrops, rock fragments, and bowlders to be of any agricultural value. Such areas are

mapped as Rough stony land. Often the areas are both steep and stony, and although they may contain small patches of soil that might be cultivated, such patches are so isolated and difficult of access that they are practically worthless. Soil of almost any of the types occurring in this region may be found in the areas mapped as Rough stony land. Usually the small quantities of soil between the stones is sandy, as the parent rocks are for the most part sandstones. On the whole, Dekalb material probably predominates.

In some places along the crests and on the steepest parts of the slopes of the mountains the rocks are almost bare of soil or vegetation, but generally the mountains support a fair forest growth. The predominant growth is spruce pine, with a scattering of oak, chestnut oak, and chestnut, and a few other trees. Recently the Federal Government has purchased large tracts of this land along the crest of Great North Mountain in an adjoining area, to be included with the Potomac Forest Reserve. The price paid for these tracts ranged from 50 cents to $1.25 an acre. Some of the less stony and more gently sloping areas of this land could be utilized for orchards, but most of it is rather inaccessible and the cost of handling the fruit would be high. This type is probably best left in forest.

SUMMARY.

Jefferson, Berkeley, and Morgan Counties lie in the extreme eastern part of West Virginia. They comprise a total area of 769 square miles, or 492,160 acres.

Physiographically the area surveyed comprises a series of broad, low valleys with intervening steep mountain ridges, extending across the area in a general northeast-southwest direction. The valleys range from about 500 to 800 feet above sea level, and the mountains rise 1,000 to 1,500 feet above the general level of the valleys. The streams have cut to depths of about 100 feet below the general level of the broad limestone valley in the eastern part of the area, and to about 200 feet below the level of the shale valleys of the western part. The general slope of the valleys is toward the northeast, and the general elevation of the valleys and mountains of the western part is higher than in the eastern part of the area. The area is drained mainly by the Potomac River and its tributaries.

The area has a population of 45,736, about two-thirds of which is rural. Martinsburg is the largest and most important town in the area. Charles Town, Berkeley Springs, Harpers Ferry, Shepherdstown, and Paw Paw are towns of considerable local importance. The area is well supplied with transportation facilities, with the exception of the upper parts of the shale valleys. The limestone-valley section is supplied with good public roads; in the remainder

of the area the roads are fair to poor. Washington and Baltimore are the principal outside markets.

The climate of the area is healthful and generally pleasant. The mean annual temperature is 52.5° F., and the mean annual precipitation is 36.57 inches, with a snowfall of 27.3 inches, as recorded at the Weather Bureau station at Martinsburg. The western part of the area has a somewhat lower temperature and a lighter precipitation than the eastern part. There is an average growing season of about 6 months.

The agriculture of the Martinsburg area consists of growing general farm crops, mainly wheat, corn, oats, buckwheat, and hay (timothy, clover, and alfalfa), stock raising, dairying, orcharding, and the production of truck crops for local markets and for canning.

The farm buildings and equipment are generally good on the limestone-valley farms, fair in the shale valleys, and poor in the mountain sections. Land values in the limestone section are much higher than those prevailing in other parts of the county.

A general form of crop rotation is followed, with minor changes to suit individual conditions. Commercial fertilizer is used and lime is applied to some extent.

Farm labor is scarce. Nearly 70 per cent of the farms are operated by the owners, according to the 1910 census. Leasing is much more prevalent in the limestone valley than in the shale valleys.

The average size of the farms is about 131 acres, and of the land in farms about 68 per cent is improved. A much larger proportion of the limestone farm land is improved than of the farm land of the shale valleys.

The average value of farm land in the area, according to the census of 1910, is $31.08 an acre. Little of the limestone-valley land can be bought for less than $100 an acre, and the better improved farms are held at a much higher price. The price of shale-valley land ranges ordinarily from $15 to $40 an acre, and the best improved farms seldom sell for more than $100 an acre. The mountain land, generally nonagricultural, is valued at $1 to $10 an acre.

The Jefferson, Berkeley, and Morgan Counties area lies in the Appalachian Mountain and Limestone Valley soil provinces, the soils of the western half belonging to the former and those of the eastern half to the latter.

The soils of the limestone valley are derived from limestones of Cambrian, Ordovician, and Silurian age. They are classed with five series, the Decatur, Hagerstown, Frederick, Frankstown, and Colbert.

The Decatur series is represented by the clay loam type. It is derived from comparatively pure blue limestone, and has a reddish-brown soil and red subsoil. This is a strong soil, well suited to wheat, corn, and grass.

The Hagerstown soils are the most extensively developed. These are brown to reddish-brown soils, derived from fairly pure limestones. They are the best general farming soils of the area.

The soils of the Frederick series have light-gray soils and red subsoils. They are derived from impure cherty limestone, and usually contain some cherty material in the soil. They are not so highly valued for general farm crops as the other limestone soils, but are well suited to orcharding.

The Frankstown series includes soils having gray surface soils and yellow subsoils, derived from highly siliceous limestones interbedded with shale and sandstone. These soils are well suited to general farming and orcharding. The gravelly silt loam occurs in well-defined ridgelike positions and while not so highly valued as the other limestone soils for general farm crops is recognized as about the best apple soil of the area.

The Colbert series is represented by a single type, the silt loam. This is a minor soil type of the limestone-valley region. It has a gray soil and yellow subsoil. It occupies poorly drained positions and is utilized mainly for pasture.

The shale soils are grouped with three soil series, the Berks, Dekalb, and Upshur.

The thin-bedded fissile black shales of the Martinsburg shale formation give rise to soils of the Berks series. These have yellowish-brown soils and subsoils, and occur in a broad belt through the limestone valley. They are not strong soils, but are utilized for ochard-ing, and to some extent for general farming.

The soils of the shale valley west of North Mountain are derived from Devonian shales. The gray shales and thin sandstones give rise to the Dekalb series. The Dekalb soils have gray soils and yellow subsoils. While these soils are rather light, they are utilized to some extent for general farming and fruit growing.

The soils of the Upshur series are derived from the red shale of the Catskill formation. They have reddish-brown soils and Indian-red subsoils. These soils are somewhat stronger than the Dekalb, and are utilized extensively for the production of peaches. They are also well suited to the production of oats.

The terrace soils of this area are developed to a small extent and are represented by two series, the Elk and Holston.

The Elk series includes types with grayish-brown to yellowish-brown soils, derived from sandstone and deposited over a red subsoil, which is residual and derived from limestone. The Elk gravelly loam, the only type mapped, is fairly well suited to general farm crops. Peaches also do well.

The silt loam is the only member of the Holston series mapped. This soil is formed of wash from sandstone and shale areas. It has

a gray to yellowish-brown soil and a yellow to yellowish-brown subsoil. It is well suited to farm crops, fruit, and potatoes.

The alluvial, or first-bottom, soils of the area are classed with three series, the Pope, Moshannon, and Huntington.

The Pope soils are derived from materials washed from sandstone and shale. They have yellowish-brown soils and subsoils. These soils are fairly well suited to corn and grass.

The Moshannon silt loam is the only representative of that series. It has a reddish-brown soil and a red subsoil, and is composed of wash from the Upshur soils. It is intermediate between the Huntington and Pope soils in productiveness.

The Huntington series is represented by a single type, the silt loam. This soil has a dark-brown to chocolate-brown soil and subsoil, and is derived from materials washed from limestone areas. It is the strongest of the bottom-land soils and is considered the best corn soil in the area.

Rough stony land includes the steep, stony mountain areas that are practically nonagricultural. The material is derived mainly from the hard, resistant sandstone of the Pocono group and the Medina white and Weverton sandstones.

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[PUBLIC RESOLUTION.—No. 9.]

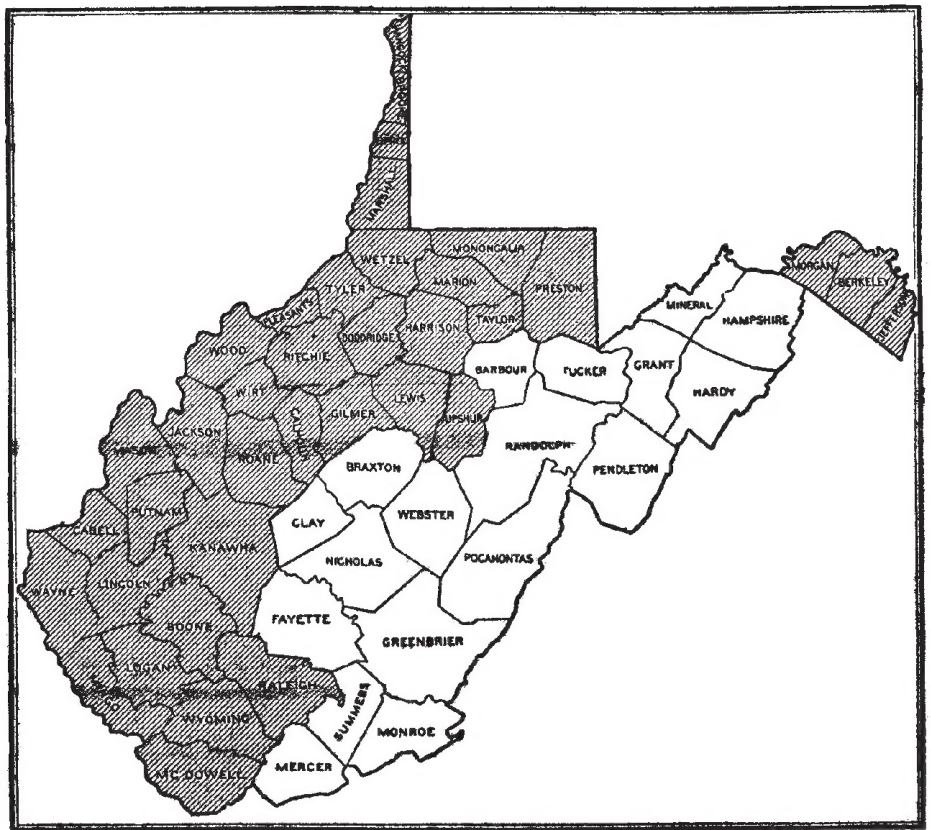
JOINT RESOLUTION Amending public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, "providing for the printing annually of the report on field operations of the Division of Soils, Department of Agriculture."

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, be amended by striking out all after the resolving clause and inserting in lieu thereof the following:

That there shall be printed ten thousand five hundred copies of the report on field operations of the Division of Soils, Department of Agriculture, of which one thousand five hundred copies shall be for the use of the Senate, three thousand copies for the use of the House of Representatives, and six thousand copies for the use of the Department of Agriculture: *Provided,* That in addition to the number of copies above provided for there shall be printed, as soon as the manuscript can be prepared, with the necessary maps and illustrations to accompany it, a report on each area surveyed, in the form of advance sheets, bound in paper covers, of which five hundred copies shall be for the use of each Senator from the State, two thousand copies for the use of each Representative for the Congressional district or districts in which the survey is made, and one thousand copies for the use of the Department of Agriculture.

Approved March 14, 1904.

[On July 1, 1901, the Division of Soils was reorganized as the Bureau of Soils.]



Areas surveyed in West Virginia.

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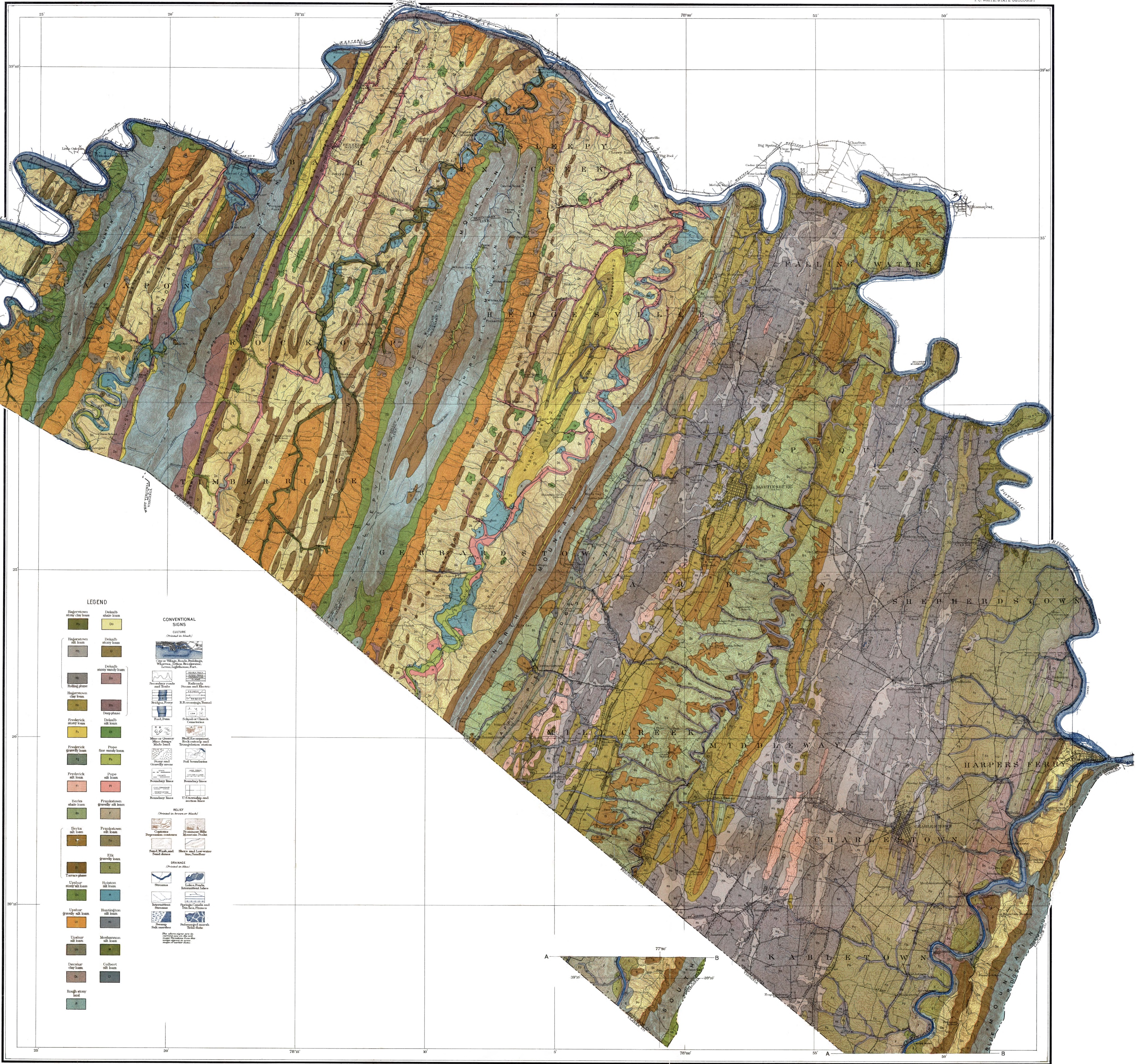
U.S. DEPT. OF AGRICULTURE
BUREAU OF SOILS
MILTON WHITNEY, CHIEF
CURTIS F. MARBUT, IN CHARGE SOIL SURVEY

SOIL MAP

WEST VIRGINIA

JEFFERSON, BERKELEY, AND MORGAN COUNTIES SHEET

WEST VIRGINIA GEOLOGICAL SURVEY
I. C. WHITE, STATE GEOLOGIST



W. Edward Hearn, Inspector, Southern Division.
Soils surveyed by W. J. Latimer.

BASE MAP FROM
U.S. GEOLOGICAL SURVEY SHEETS

Scale $\frac{1}{62500}$

Contour interval 20 feet.
Datum is mean sea level.

SNYDER & BLACK, N.Y.

Field Operations
Bureau of Soils
1916